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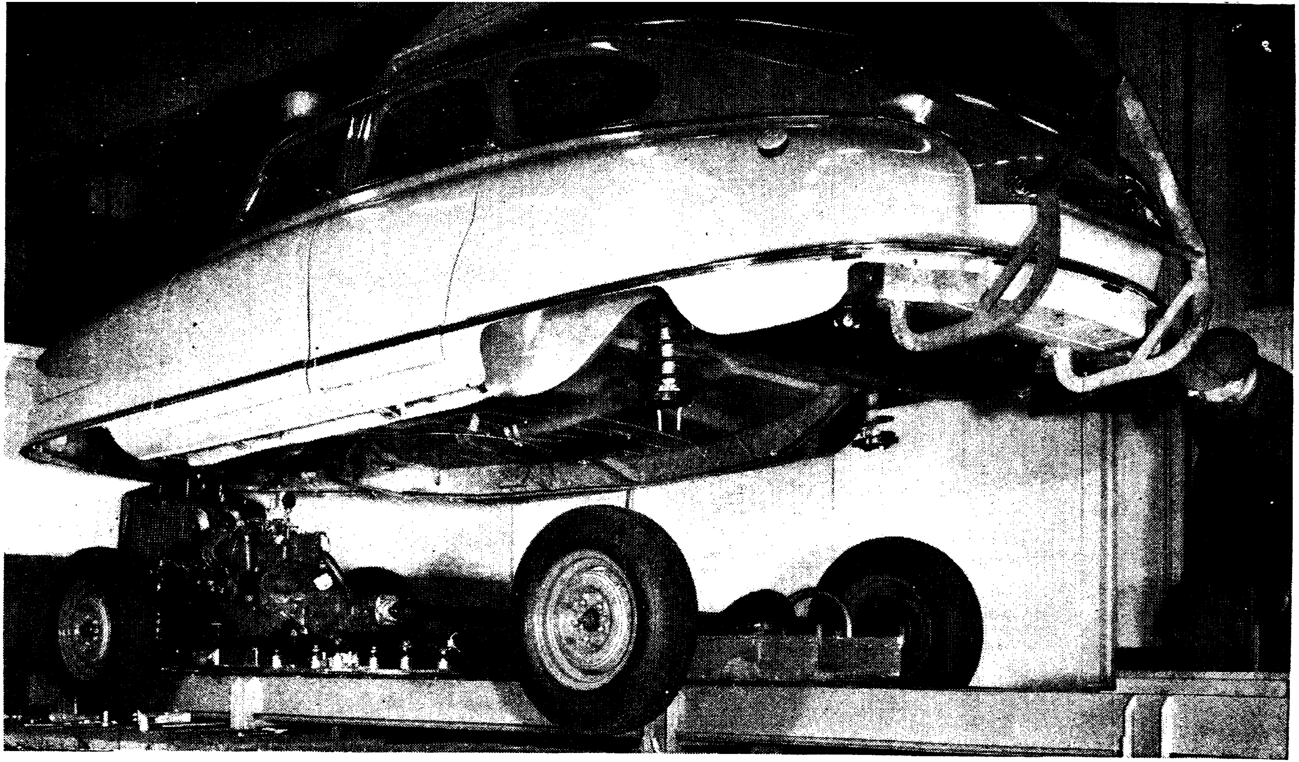

With emphasis on beauty of body lines and finish, the man who masters automotive body and fender repairs reaps rich rewards.

AUTOMOTIVE BODY
AND
FENDER REPAIRS

By

C. E. (Ed) PACKER

Member, Society of Automotive Engineers

Author, "Automotive Service Management"
"Cooling System Service and Radiator Repairing"
"Manual for Plymouth Owners"

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THIRD EDITION

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PREFACE TO THE THIRD EDITION

In this new and larger edition of *Automotive Body and Fender Repairs* are many vital money-making operations including:

Frame Straightening in all of its various phases

Spraying Techniques for enamels and lacquers with photographic analysis of refinishing problems

Flock Coating

Infra-Red Paint Drying

Equipment for Profitable Repainting needed by the small, medium, or large shop listed and pictured

Servicing Automatic Top on convertibles

Servicing Trim Units

Cutting Safety Glass to fit

Upholstery Work with curled hair, air foam, and other materials

In addition, *Getting a Job* and *Improving One's Position* in this high-pay specialty is discussed in a frank and practicable manner.

These additions and enlargements with many new illustrations keep *Automotive Body and Fender Repairs*—the original book in this skilled trade—*the leading and most complete work of its kind.*

C. E. (Ed) Packer

PREFACE

Experience is, without doubt, the best teacher. In this book is combined the service experience of many of the outstanding organizations in their respective fields. The author acknowledges with deep appreciation the invaluable assistance of the following:

Allen Electric Company
L. B. Allen Company
Bear Manufacturing Company
Blackhawk Manufacturing Company
Edward G. Budd Manufacturing Company
Buick Motor Division of General Motors Corporation
Cadillac Motor Car Division of General Motors Corporation
Chevrolet Motor Division of General Motors Corporation
DeSoto Division of Chrysler Corporation
The DeVilbiss Company
Dodge Division of the Chrysler Corporation
E. I. du Pont de Nemours & Company
The Fairmount Tool and Forging Company
Fisher Body Service Corporation
Ford Division of Ford Motor Company
Ernest Holmes Company
Hudson Motor Car Company
Independent Pneumatic Tool Company
Mall Tool Company
Nash Motors
Oakite Products, Incorporated
Packard Motor Car Company
Plymouth Division of Chrysler Corporation
Pontiac Motor Division of General Motors Corporation
The Sherwin-Williams Company
The Stanley Works
The Studebaker Corporation
The United States Electrical Tool Company
Watervliet Tool Company, Incorporated
Weaver Manufacturing Company
Willys-Overland Motors, Incorporated

To save time in making the experience of some of the best automotive engineers and service men of the country your experience, the author here presents what he feels to be the most practical and complete work on sheet metal, upholstery cleaning, and top work to date.

There are two ways that one may get into the profitable work of automotive body and fender service. One is by serving years of apprenticeship, working in a shop and "picking up" the trade. The other is to study this book in spare moments and then apply the practical things that it points out. The later is by all odds the fastest, easiest, and most profitable. It saves learning the wrong way. It saves "skin off your knuckles" in many instances. But either way takes effort.

The effort expended in developing your knowledge, however, is an investment that no one can ever take from you, and which will pay increasing dividends as the years roll by.

Specifically, the author wishes to offer sincere thanks to the following for their especially generous co-operation in providing illustrations and instructions covering service work in their various fields:

Air Reduction Sales Company for exceptionally complete data on setting up and operating an oxyacetylene welder

The Allen Electric Company for the material on arc and spot welding

Bear Manufacturing Company for the instructions and illustrations on frame straightening

Edward G. Budd Company for information on door fitting

Buick Motor Division of General Motors Corporation for help on door fitting, trim work, and for the complete information on cleaning upholstery

Chevrolet Motor Division of General Motors Corporation for data on fender repairing and lock service

The DeVilbiss Company for lists and pictures of refinishing equipment needed in various shops

E. I. du Pont de Nemours & Company for the information on spraying enamel and lacquers, and for the pictorial study of painting problems

The Fairmount Tool and Forging Company for suggestions on selection of tools, information on metal shrinking, etc.

Fisher Body Service Corporation for much general information and for detailed instructions on replacing headliners

Plymouth Division of Chrysler Corporation for details on door and top repairing by panel replacement

C. E. (Ed) Packer

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CHAPTER I

THE MARKET FOR BODY AND FENDER SERVICE

Two things sell today's automobiles—performance and beauty. And of these two many agree that beauty is the dominant factor (Fig. 1). This beauty is conceived by the artist, and made real and practicable by ceaseless work in the sheet metal and finishing departments of the automobile factories.

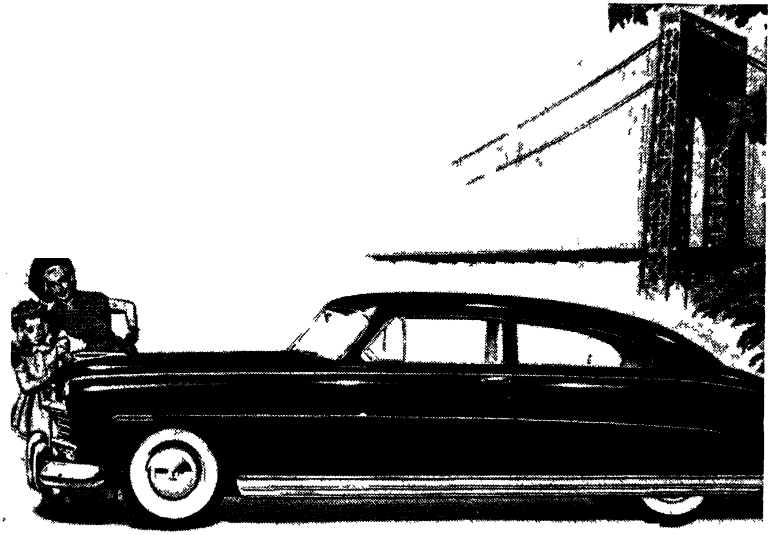


Fig. 1. Keeping the beauty in cars requires thousands of body and fender repair men.

But many things conspire to mar this beauty. Today's cars travel faster than their predecessors. There are more cars on the road. Parking is becoming increasingly difficult. So the net result is damaged fenders, smashed bodies, soiled upholstery, which means plenty of work for those who have the equipment and the knowledge necessary for performing it (see Fig. 2).

Let's not study the potential market made up of the more than 40 million vehicles on our roads today with their more than 100 million fenders, over 150 million panes of glass, and so on. This may be impressive, but what is more impressive is the fact that **most body shops that turn out really good work are also turning away work.**

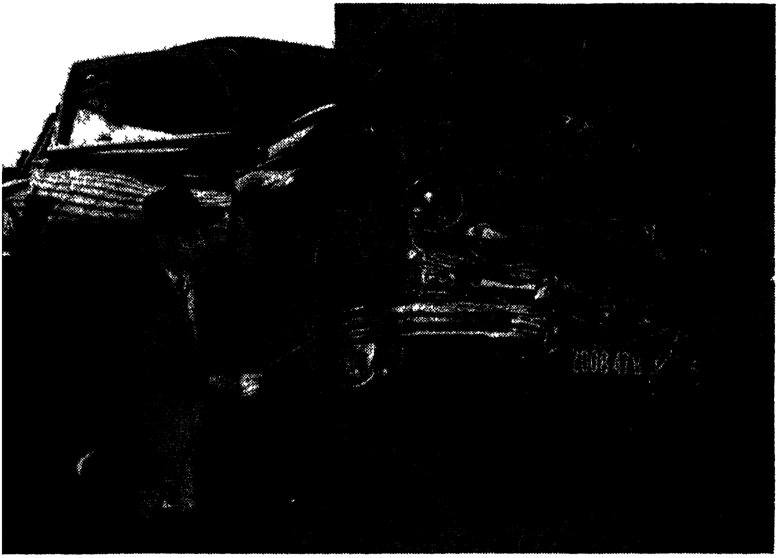


Fig. 2. Skilled body man making estimate on a big-pay job.

Why is this? In some cases they are not working as efficiently as they might, in spite of turning out good work, and in other cases they simply cannot hire capable men to do all the work that comes to them.

Even in a time when jobs were scarce, when many organizations were laying off old employees, it was not unusual to pick up a newspaper and read advertisements as follows

WANTED: Mechanic, preference given to one able to do body and fender work. Apply

....

WANTED: Top and trim man with some knowledge of refinishing. Apply...........
ready to go to work. ....Garage,
............................Street.

And such ads ran day after day because **the men who had the required ability already had good jobs!**

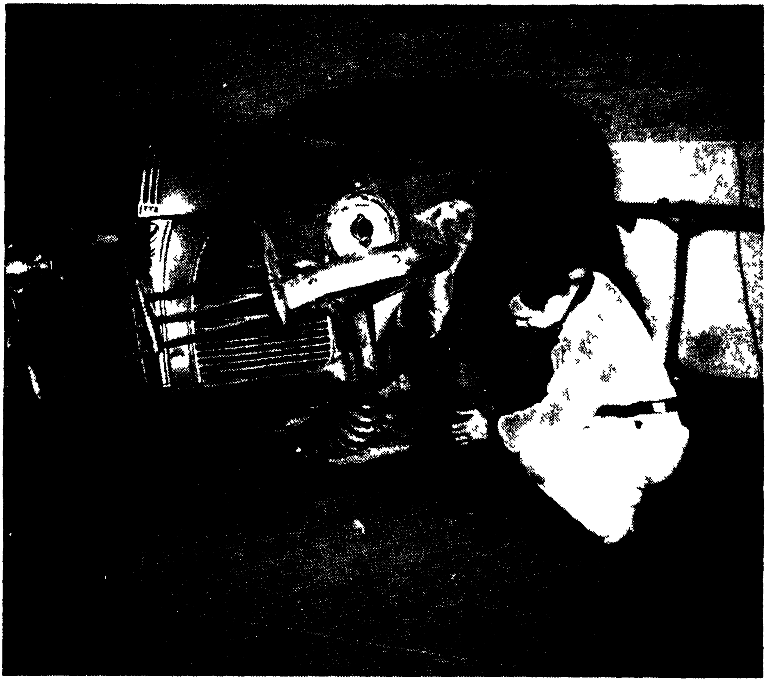


Fig. 3. Used-car appearance conditioning is a profitable field.

The explanation for the demand for capable body and fender service men is simple. When times are bad, car owners will make the old car do another year, or two, or three. At the same time they don't like to be branded among their friends and neighbors as being "hard up" so many of them become excellent customers of the better body shops or of those shops that include body work along with their other services.

When times are good, the big market is in putting used cars in shape to sell. Few car dealers are equipped to do their own appearance-reconditioning of used cars. They may do the straight mechanical work, but most of them prefer to turn over all body, fender, and related work to specialists (Fig. 3).

So whether times are good or bad the man who can straighten fenders, repair wrecked bodies, fix worn or torn tops and trim is sure of a job—**and a good one.**

But don't get us wrong. Reading this book will not make a skilled worker of you. However, if you have a liking for this kind of work and really want to become a skilled worker, then this book will help you to succeed much faster and much more surely than you would if you relied on your own experience alone.

CHAPTER II

PERSONAL REQUIREMENTS FOR SUCCESS

Men who are making good in body and fender work have certain characteristics over and above their purely technical knowledge of the job. Of course a liking for one's job is a fundamental for success in any line of endeavor. But one is likely to enjoy his work when he becomes proficient in it, for we all like to do whatever we can do well.

The author fears "preaching," but since it has been his good fortune to have been service manager of a shop employing as many as eighty-five men in the service department he is going to pass on his observations on what makes a really outstanding body and fender man.

He Is a Salesman

Your really successful body and fender repairman is a salesman—for of what value is the ability to do the work if you can't sell the job? Salesmanship, today, does not mean putting something over. It merely means explaining a customer's needs to him in such a way that he will recognize the need and recognize the ability of the salesman to meet that need.

The successful service man will always put himself in the motorist's place. He will not attempt to sell the same quality of straightening job to the owner of an eight-year-old car that he would urge upon the owner of a new car.

He will be a good listener and be sure he knows just what the owner wants, or thinks he wants, before he makes any attempt to explain what the car really needs. Very frequently in an attempt to keep the cost down an owner will try to belittle the amount of work required to put the car in shape. But for the mechanic to be undiplomatic at this point would probably result in the loss of the job.

Most successful shops have a number of jobs going through at a time, and when an owner fails to understand what work is required the most effective procedure is to take him over to some other job and point out the steps required for making repairs.

He Is a Student

In addition to being a salesman, the most successful body and fender service man is a student—a student of human nature, of course, in order to be a good salesman, but also a student of every kind of body and fender damage.

No two smash-ups are exactly alike. That's what makes this work interesting. But this is what also makes it a bit difficult, though not too difficult.

When the body, fenders, frame, and other parts of the car were formed, great pressure created certain contours. And when an accident occurs, great pressure again is at work, but this time it is upsetting the original contours. So to restore any damaged metal portion to its original form requires the application of pressure in a direction opposite to the pressure that did the damage.

And the mechanic who is "slap dashy," who rushes into a job without looking it over carefully first, will probably make himself more work than was caused by the original accident. And this lost motion must be paid for. If charged to the customer, the customer will sooner or later be lost. If the wasted time is charged to overhead, profit will be lost.

So the old saying about measuring twice and cutting once certainly applies in this work. Time spent in studying how the accident occurred, and just where the pressure must be applied to correct the damage is the best investment a service man can make.

He Is a Mechanic

Don't ever get the notion that a body and trim man is a cross between a tinner and a tailor. Far from it! He is a mechanic PLUS. In fact he is a craftsman, for considerable native mechanical ability is desirable in a body and fender man if he is to "savvy" door locks, window lifts, seat adjusters, metal working, trim work, and refinishing.

And when we say he is a "mechanic" we mean it in the fullest sense. He is not a "grease monkey," but a man who has spent time, plus mental and physical effort, to learn his trade. The condition of his clothes, his hands, his face, and his tools shows that here is a man who stands at the head of his profession (Fig. 4).

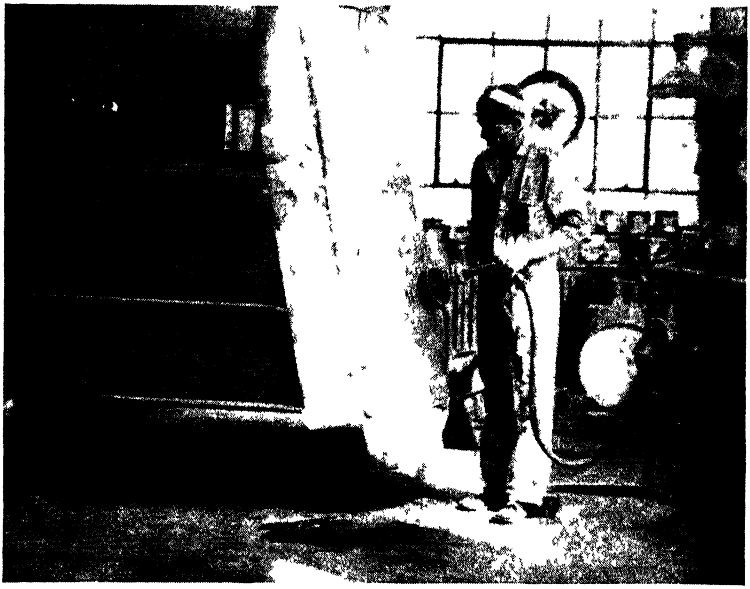


Fig. 4. A good mechanic can be told by his dress, his tools, and his general appearance.

He Is Honest

Not as a matter of morals, perhaps, but just because it is good business to be honest, the best shop man will never take advantage of a customer. And in body and trim work, where so much of the job can be covered up, where poor welds can be painted over (and may hold), where refinishing can be done over metal that was not properly cleaned up, there is always the temptation to "cut corners," to give the customer a little less than he paid for. Some do this. Some get away with it for quite a while. But eventually they get caught. And a reputation, once destroyed, is mighty hard to bring back.

So the man who is honest is naturally fitted to body and fender work where there are many opportunities to "cut corners" but where it is never good business to do so.

He Is Punctual

Above all things our successful service man is punctual. He respects a promise. A car promised for delivery at 4:00 P.M. must be ready at 4:00 P.M. without fail. Not only is he punctual, but he is man enough in those instances where something develops to make it quite impossible to have the job ready when promised to call the customer in advance and tell him so. If it is necessary to tell **her** so, then it is all the more important. The female of the species is deadlier than the male by far when it comes to a matter of going over to the service station to get the car, only to find that it isn't quite ready.

So in this business he looks at the repair job from the customer's angle; sells the job that is needed, studies just how it must be handled, turns out work that he is proud to call his own, completes the work in an entirely honest manner, and has it finished on time or tells the owner, in advance of the time for which it is promised, that an unavoidable delay will make completion of the work on schedule impossible.

If you can meet the requirements laid down here, your success in body and fender work is assured.

CHAPTER III

LOCATING AND LAYING OUT A SHOP

As your shop layout will influence directly the success of your venture, it deserves all the attention you can give it. The main things to consider are: accessibility, ease of entering and leaving, natural light and ventilation, arrangement of office and stock room.

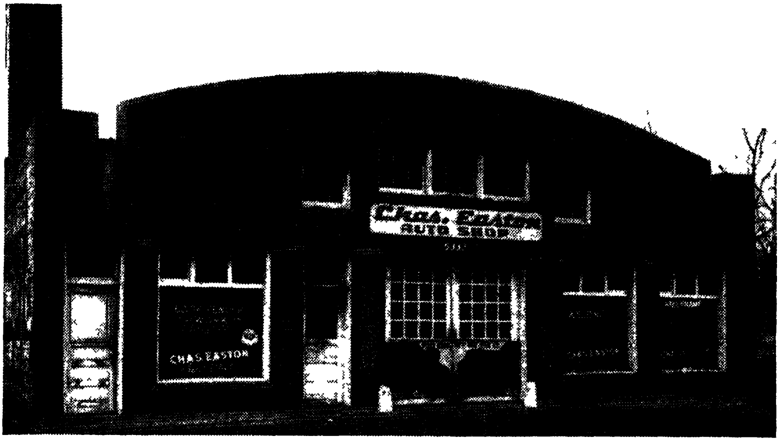


Fig. 5. On a busy street, this well-identified body and fender shop picks up a good volume of work.

Location

To have your shop located in the busiest section of your town has its advantages and disadvantages. Being close to many motorists is desirable, for as they pass your place they will be constantly reminded of you and when the need for service arises they will probably patronize you (Fig. 5). And being nearby, either they will be willing to walk back to their place of business or to their home, or driving them back (as is quite the custom now) will not take much of your time.

The big disadvantage of having a shop in a busy section is that the rent is generally relatively high. This, however, may be offset by the extra business obtained by reason of the location. Another disadvantage that may be quite serious may arise from the difficulty with which customers may get into your place due to traffic conditions. Many motorists hesitate to tie up traffic trying to get into a driveway. This may not be a very serious matter unless the street you select should become designated as a one-way street and be used by high-speed traffic.

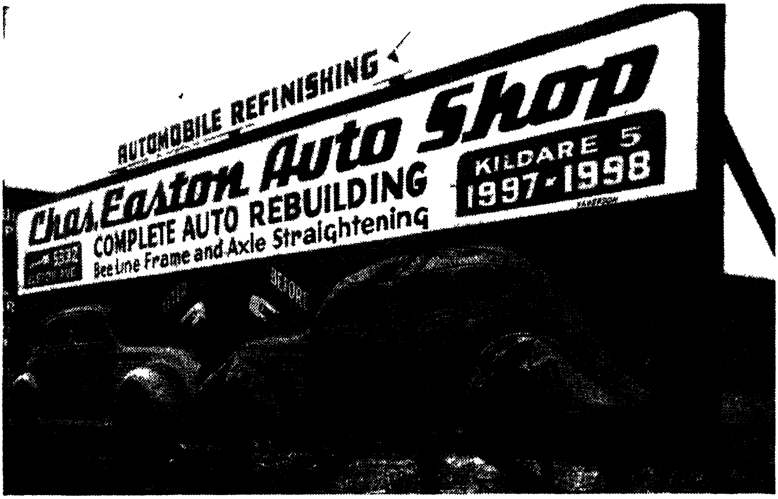


Fig. 6. By showing the type of work that is done in this shop, this sign is proving to be a business getter.

Shop owners who have located on the outskirts of a town have often done well as a result of using business cards with a map showing their location with this copy under it:

> No charge for picking up or delivering your car. Free cab service from our shop to any point in town.

Make It Easy To Enter and Leave

Even though it may take away from your working space, keep your doors and aisles wide. Shop men become so familiar with the problem of driving in their own shop that they have no idea how afraid of it many motorists are. And no motorist will admit he is afraid of hitting a post or some other car. So he (or she!) just keeps away and never tells you why. Therefore, difficulty in driving into your shop or out of it may very easily be a drawback too serious to overcome.

Light and Ventilation

To make your shop as pleasant as possible for customers and workers is the best of business. And nothing is quite so important in this respect as plenty of light and air. If in an open section of the city, or out in the country, this matter of light and ventilation can probably be taken care of by seeing that there are plenty of windows or sky lights.

But if nearby buildings shut off light and air, then before signing any lease or buying any piece of property it would be wise to find out from lighting and ventilating contractors just what adequate light and ventilation equipment will cost to install and to run.

Locating the Office

Just where will you have your office? Your stock room? These are important matters. First of all, some office work will be necessary, but it is not wise for the owner of a shop, especially a small one or one that is just becoming established, to "hide out" in an office. Customers don't like this. And customers won't wait for someone to finish a telephone conversation or complete the addition of a column of figures before coming out to greet them. Don't ask us why a steering wheel in a man's hand makes him the most restless thing on earth, but it seems to do just this. Therefore accept things as they are and make all plans so that the customer is greeted the instant he drives on your service floor. An office along the driveway with a glass partition between it and the drive will generally prove the best arrangement.

Some offices are located on balconies; but these lack light and ventilation and are generally excessively hot. In addition they suggest that the owner is "hiding" from his customers.

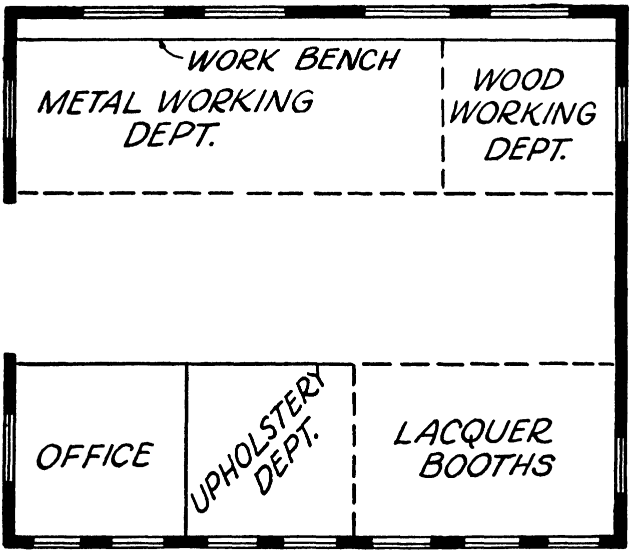


Fig. 7. A suggested layout where a body and fender department is to be added to an already established shop.

Planning the Stock Room

When planning the stock room remember that it should be close to the shop to save the time of mechanics, but it should also be near the office. For this reason it is generally connected directly at the back of the office with a door or parts window leading into the office and another one to the shop. In this way customers who drop in to buy parts over the counter may be served as readily as the men in the shop.

Consider the Climate

Where the weather is generally warm, a very open shop is not only desirable but almost necessary. And on the other hand the owner of a shop located where there are many months of winter weather could ill afford to heat a place that is too big or too open. And incidentally, look well to the condition of the heating plant before signing anything.

Briefly, the best way of determining exactly what is best for any particular locality is to drop in and visit the various shop owners who are already there. We've visited great numbers of shops and always have been received with the greatest of courtesy. Ask them just how they like their present layout. Ask them, also, what they would change if they were free to move or rebuild. This latter is important. Then write down their comments briefly and try to find out what they who are already in the business would find ideal. You won't find it, but you'll come a lot closer than you would if you didn't go at it in this systematic way.

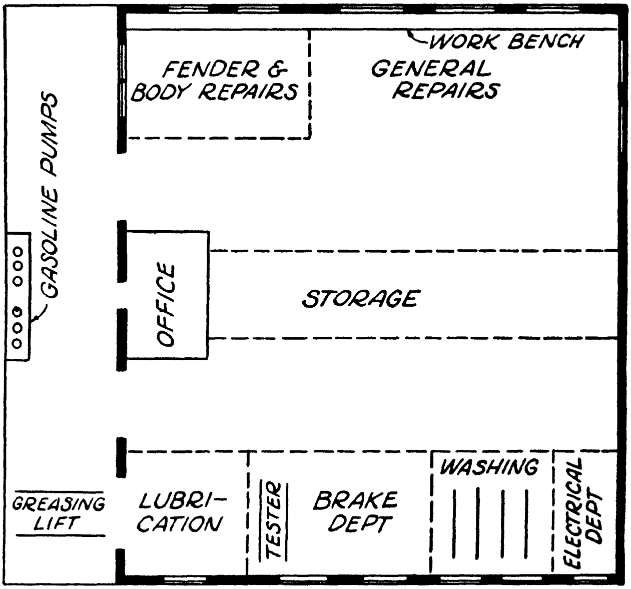


Fig. 8. A complete body and fender service station featuring gasoline pumps to make customer contacts.

CHAPTER IV

CHOOSING THE EQUIPMENT

In choosing your equipment you will be influenced by how completely you intend to equip and by the funds or credit available. A beginner will do well to go slowly in the purchase of equipment and may profit greatly by inquiring of other shop operators as to how certain makes are standing up on the job.

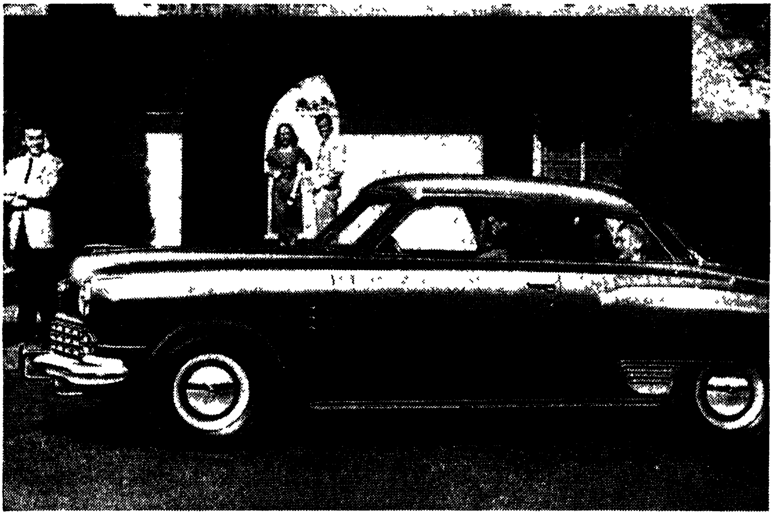


Fig. 9. The more modern the car the more likely it is that the owner will seek a class A shop when service is needed.

It is obviously beyond the scope of any book to state that a shop man must have this or that tool or piece of equipment, but what is said here may serve as a reminder when equipping.

Shops are grouped into one of three classes by the Fairmount Tool and Forging Company according to the way they are set up to do various kinds of work.

Scope of Service

Class A Service usually includes facilities for rendering complete body and fender repair and refinishing service (Fig. 9), and the rebuilding of totally wrecked vehicles. It embraces frame and axle straightening, woodwork, upholstering, trimming, and complete spray painting and related services.

Class B Service specializes on all classes of fender repairing and less difficult body and top repair (like jobs in Fig. 3) and touch-up spray painting. A profitable service for these shops is the dressing up of used cars or trade-ins for resale.

Class C Service is limited to the repair of fenders and minor body injuries, including touch-up painting by brush. These shops frequently lose profitable opportunities because of an ill-founded fear of imaginary difficulties of complete body and fender refinishing service.

Quick Check of Equipment

While the following tabulation is not presented as complete in every respect, still it will prove helpful when checking needs for shops according to how extensively they intend to go into body and fender work. The "×" in the shop classification column indicates that shops in this category should have this particular item.

EQUIPMENT

Class			
A	B	C	
×	×		**Air compressor**
×	×		**Air hose, nozzles, gauges**
×	×	×	**Anvil**
×	×		**Bench grinder**
×	×		**Blow torch for soldering**
×	×	×	**Body and fender tools**
×			**Body builders clamps**
×			**Body jack**
×	×		**Brush (wire rotary)**
×	×		**C clamps**
×	×	×	**Creeper**
×			**Electric band saw**
×	×		**Electric drill**
×	×	×	**Electric extension cord**
×	×		**Electric lamp stand**
×	×		**Electric polisher and sander**

Class			
A	B	C	
×			Frame straightener
×			Glue pot
×	×	×	Horses and trestles
×	×	×	Gas furnace for soldering coppers
×	×	×	Garage jacks
×	×		Paint spray gun
×			Paint spray booth
×			Exhaust fan for spray
×			Light reflectors
×	×		Shop coats

Class			
A	B	C	
×	×		Shop covers (fender and seat)
×			Taps and dies
×	×	×	Tool racks
×			Vacuum cleaner
×	×	×	Vises
×	×	×	Welding outfit (complete with cutting torch)
×	×		Wheel pullers
×	×	×	Work benches

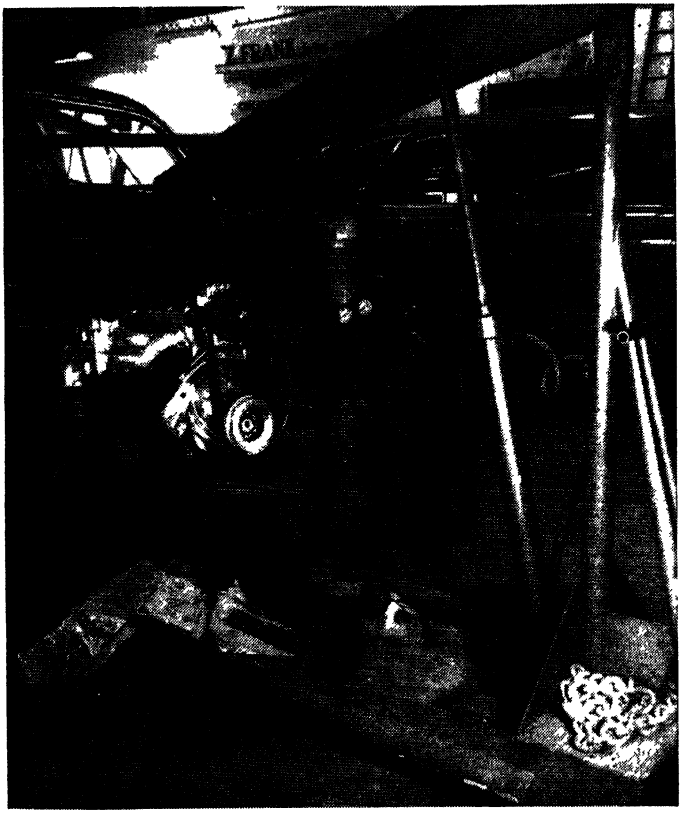


Fig. 10. This portable hoist handles engines and bodies with ease.

TOOLS

Class			
A	B	C	
×	×		Bevel square
×	×		Bit brace
×	×	×	Bolt extractors
×	×	×	Breast drill
×	×	×	Brushes, paint
×	×	×	Center punches
×	×	×	Chisels
×	×	×	Drifts
×	×	×	Drills (wood and steel)
×	×	×	Files (body and mill)
×	×	×	Hammers (ball peen, engrs.)
×	×		Hammers (trimmers)
×	×	×	Hand vise
×	×	×	Hack saw
×	×		Hub cap wrench

Class			
A	B	C	
×	×	×	Mallets
×	×	×	Pliers
×	×		Pry bars
×	×	×	Screw drivers
×	×	×	Soldering coppers
×			Striping pencils
×	×		Tin shears
×	×	×	Wire Brush
×			Wood brace and bit
×	×		Wood chisels
×			Wood plane
×			Wood saw
×	×	×	Wrenches, end
×	×	×	Wrenches, socket
×	×	×	Body and fender tools

SUPPLIES

Class			
A	B	C	
×	×	×	Abrasive cloth and paper
×	×		Abrasive disks
×	×		Asbestos
×	×	×	Body filler metal, steel and aluminum
×	×	×	Bolts, nuts, and washers
×	×	×	Electric light bulbs
×			Glue
×	×	×	Grinding wheels
×	×	×	Hack saw blades

Class			
A	B	C	
×	×	×	Lacquers
×	×		Masking tape
×	×	×	Painting materials
×	×	×	Penetrating oil
×	×		Polishing materials
×	×		Running board material
×	×		Tacks and nails
×	×	×	Welding supplies
×	×	×	Wiping rags
×	×		Wood and metal screws

Buy the Best You Can Afford

It should always be remembered that in buying equipment the purchase is not being made for a day, a week, or a month, but that the item will be used for years. Therefore, the purchase should be of *quality* equipment and can very properly be bought on time, if necessary, and paid for out of profits.

Such time buying may be handled in various ways: through the jobber who sells the equipment, through a special finance house, or through your own bank. While it may give one a good feeling to pay cash, it should be remembered that really big business is not built this way. Since money costs probably 6 per cent a year and good equipment, well used, will return many times this amount, it is good business to buy needed equipment and tools on time.

Portable Power Press

One item not included in the equipment tabulation and which is finding increasing favor in various shops, especially on difficult body work, is "Porto-Power," a portable and powerful press that can be adapted to nearly any pressing, bending, or straightening operation.

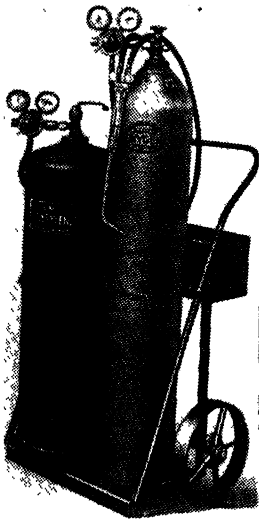


Fig. 11. No shop can be considered complete without welding equipment.

Briefly this equipment is a hydraulic cylinder or pump connected to the hydraulic ram by a flexible tube. This arrangement makes for compactness of the ram, which, by means of various attachments, can be placed on practically any job needing high pressure under sure control. Then with the pump conveniently located outside of the job the mechanic can develop just the pressure needed to get the results desired. The whole outfit is carried on a special rolling stand. See Chapter XIII for illustrations of this.

Buy Complete Welding Equipment

In welding equipment, perhaps more than in some other items, completeness and quality are particularly important. In the oxy-acetylene welding equipment it is best to buy a complete outfit which will include a cutting torch (Fig. 11).

Fig. 12. Electric arc welding is indispensable in most body and fender repair operations.

And in this type of equipment one should watch the size and weight because proper body and fender work will never require a large flame. The smaller torch is easier to handle and less expensive to operate. The big torch would be used for straightening bent axles and steering arms—**and this should never be done with heat!**

Speaking of complete electrical welding, it is well to consider an electrical outfit that does both arc and spot welding (Figs. 12, 13). The spot welding is especially desirable for steel top replacement and for installing or repairing various panels.

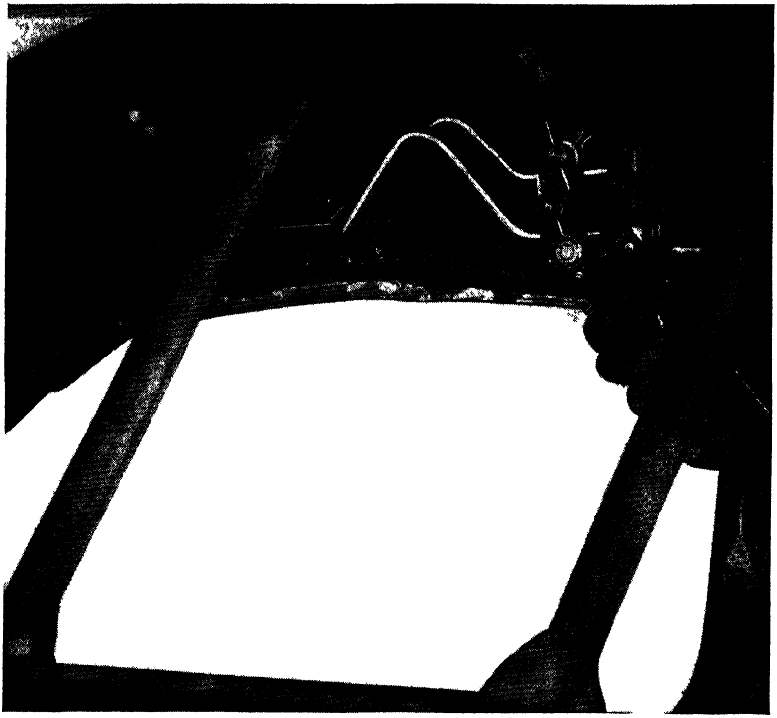


Fig. 13. The same equipment that provides the current for arc welding provides the current for spot welding.

As a means of visualizing some of the modern equipment now on the market to make body and fender work easier and more profitable than ever before the following are shown:

Fig. 14. A scientific headlight aligner is desirable in the really complete shop.

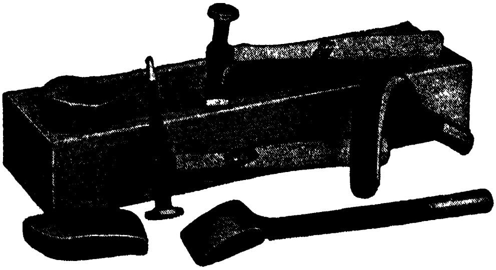


Fig. 15. Minimum equipment in the way of hammers and dollies.

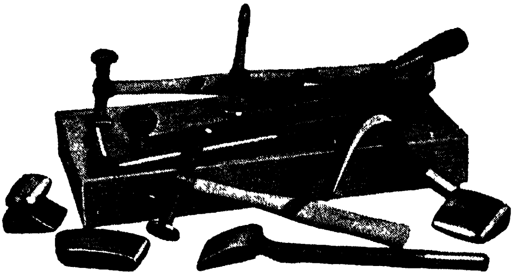


Fig. 16. A ten-piece tool kit weighing 24 pounds.

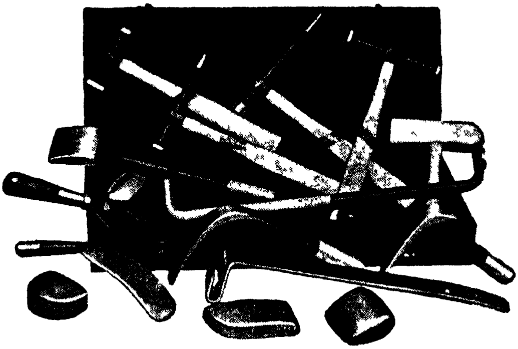


Fig. 17. A still more complete set that costs "a week's pay."

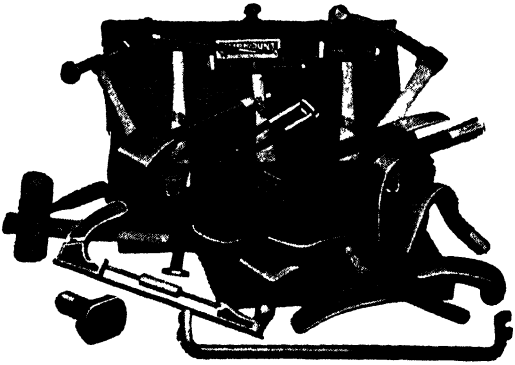


Fig. 18. A 21-tool, 53-pound outfit containing every needed hand tool.

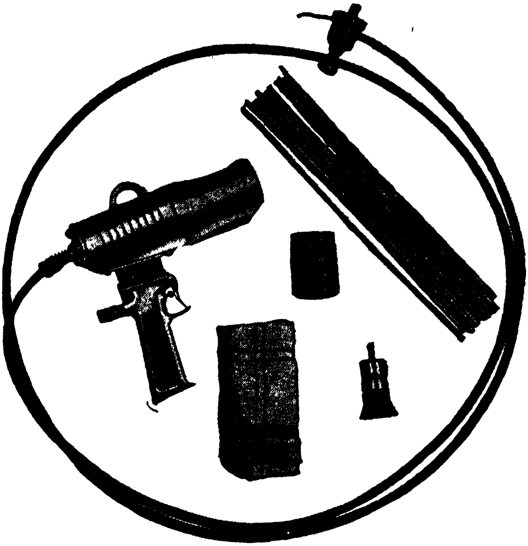


Fig. 19. A metal spray gun that does a great job of building up damaged areas.

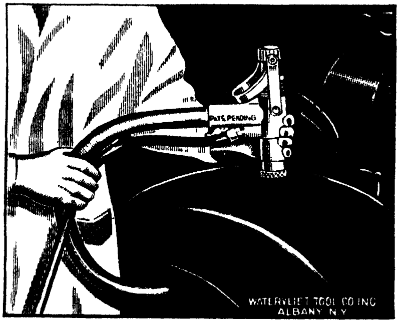


Fig. 20. Where one can reach both sides of the dent, this air hammer "irons" out the irregularities quickly.

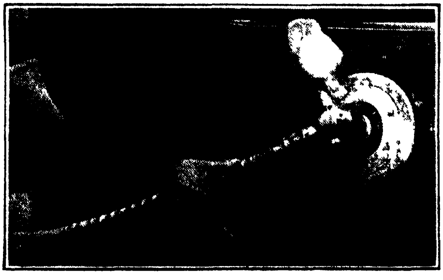


Fig. 21. Motor-driven flexible shaft sander that makes the surface slick as new.

CHAPTER V

SELECTION AND CARE OF HAND TOOLS

An impressive assortment of quality tools has been the difference between getting a good job and not getting a job with many a mechanic. And keeping a "toter" of tools in good order has helped many a man hold a job. Tool kits generally just grow. They are practically never purchased as complete outfits. But styles in cars and tools change and you can't do "V-8 service" with "model T" tools.

Fortunately in body and fender work it is possible to acquire a complete and valuable set of tools as the need for certain tools is felt or the ability to use them develops. Anywhere from approximately $10 to $40 or so will fix a man up with a very effective set of sheet metal tools as was seen in chapter IV. But of course the man who really loves his work, and who as a consequence is "going places" in his job, will always be on the lookout for new tools or better tools so that he may do a better job or do the same job faster and so make more money.

The Why of Sheet Metal Working Tools

As a means of selecting the needed tools with a definite knowledge of what they can do and what they cannot do the following has been compiled.

Hammers—Their Description

Care should be exercised to select a good quality, well-balanced hammer of the proper weight and design for the work for which it is intended to be used. A hammer used for dinging, weighing about 9 or 10 ounces is the most popular. For bumping purposes, hammers ranging from 14 ounces to about 2 pounds are used, depending upon their design and extent of the damage to be repaired. Fig. 22

illustrates a bumping hammer and Fig. 23 a dinging hammer.

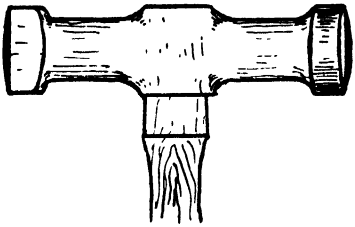


Fig. 22. Bumping hammer. Note the heavy construction.

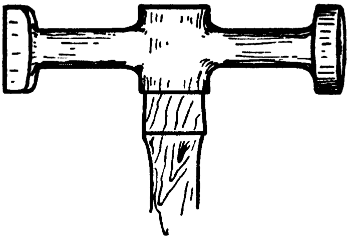


Fig. 23. Binging hammer. Note lighter construction.

Note the heavier construction of the bumping or roughing hammer. It is used for heavier and rougher work, whereas the dinging hammer is used with lighter blows for finishing work, as its weight is much less than that of the former. Also note the difference in the faces of each hammer. The faces of the roughing hammer are considerably more crowned than those of the dinging hammer for the reason that the former is usually used on the inside or underside of crowned surfaces, whereas the dinging hammer is used on the outside or top of these surfaces. This is shown somewhat exaggerated in Figs. 24 and 25.

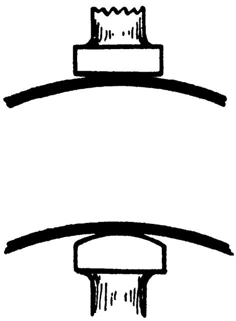


Fig. 24. The flat side of any hammer is always used on the convex surfaces.

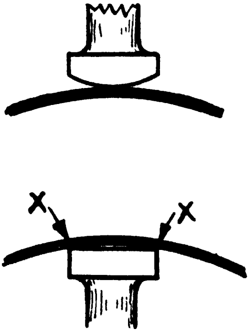


Fig. 25. The flat surface of a hammer used on the concaved surfaces would do damage as indicated at *X*.

Obviously a flat-faced hammer used on the underside of the crown in Fig. 25 would nick the top surface at points marked X. Likewise, a round-faced hammer used on the top surface would dent it. Referring again to Figs. 22 and 23, note that both the bumping and dinging hammers have round and square faces on opposite ends. This is to accommodate different shapes of work, the square face being used along straight lines and the round one in round corners and radii. All of these hammers are made in different weights for different purposes.

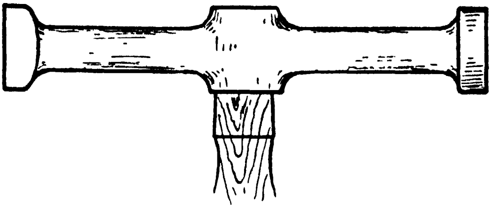


Fig. 26. Long headed hammer for working into deep-crowned fenders.

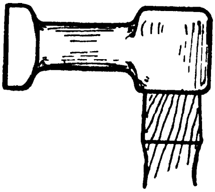


Fig. 27. Half hammer for use where little space is available for swinging the hammer.

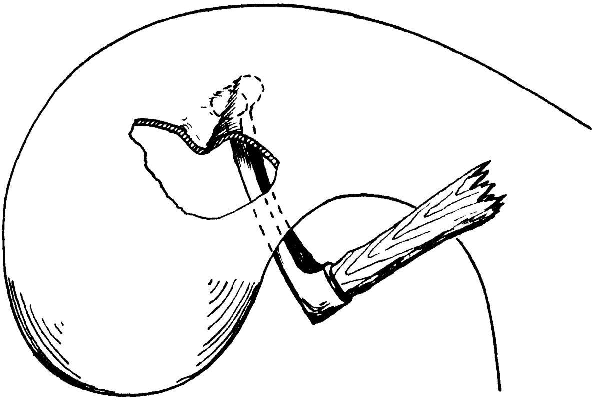


Fig. 28. Fender bumper for working on the deep fenders of todays' cars.

Dividing further the types of hammers, Fig. 26 illustrates a long-headed hammer for working into deep-crowned fenders, or over woodwork or braces. Fig. 27 shows a half hammer which is used in places where only a short swing is possible. Fig. 28 shows what is known as a fender bumper, used in bumping or roughing out fender dents. It clears the tire in most cases, saving time of removing the wheel. It is also used on bodies.

All of these hammers are important and each serves a definite purpose. A mechanic who knows his tools and uses a light tool for light work, a heavy tool for heavy work, and a special tool for special work will accomplish his work in less time and with less effort than one who uses any tool that may be near at hand.

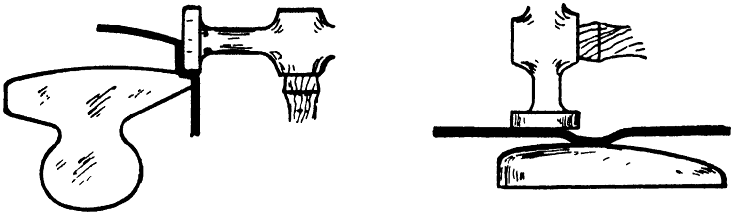
Polishing Hammer and Dolly Faces

When hammers or dolly blocks become scratched, the scratches must be removed to prevent damaging the finish when dinging painted or lacquered surfaces. These scratches and burrs should be rubbed out on a fine oil stone, and then the faces polished. The polishing procedure which follows is recommended because of its excellent results:

Secure a piece of ⅞-inch poplar about 4 × 10 inches smooth on one side. On this board prepare a polishing abrasive composed of hydrated lime and denatured alcohol. The lime is moistened with the alcohol to form a paste. The hammer or dolly faces rubbed on this board will be highly polished to equal their original condition. Fine emery or other abrasives are too coarse for this kind of work. Care must be exercised to preserve the original roundness of the faces.

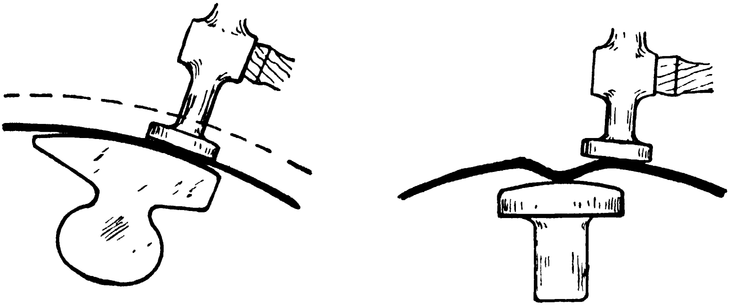
Dolly Blocks

A dolly block is really a hand anvil, having various shapes for different curved surfaces. A wide variety of these shapes is necessary to do complete work. Obviously one dolly block cannot carry more than a few contours, so that to incorporate all of the many shapes encountered, a full variety of blocks is required (Fig. 29). Dolly block surfaces, like hammer faces, must be kept free from nicks and scratches and be polished to avoid marring the sheet metal.



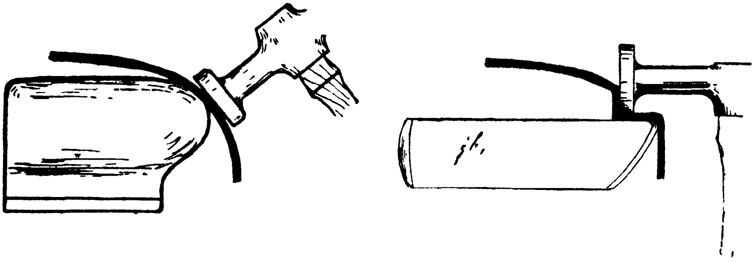
DINGING A FLANGE

DINGING FLAT SURFACE



DINGING CONVEX SURFACE

DINGING CROWNED SURFACE



DINGING BODY CORNER

DINGING OFFSET

Fig. 29. Various kinds of dolly blocks showing the kind of work for which each is fitted.

Spoons

The addition to the shop of tools known as spoons, and serving a purpose similar to dollies, makes possible the making of more repairs by bumping and dinging. A spoon permits dinging on dents which are inaccessible for a dolly block, such as between wood frame-work and body metal, behind upholstery, under windows, under fender brackets, etc. The spoons are provided with longer reach, as well as with various contours. Fig. 30 shows an assortment of the various types of spoons in general use.

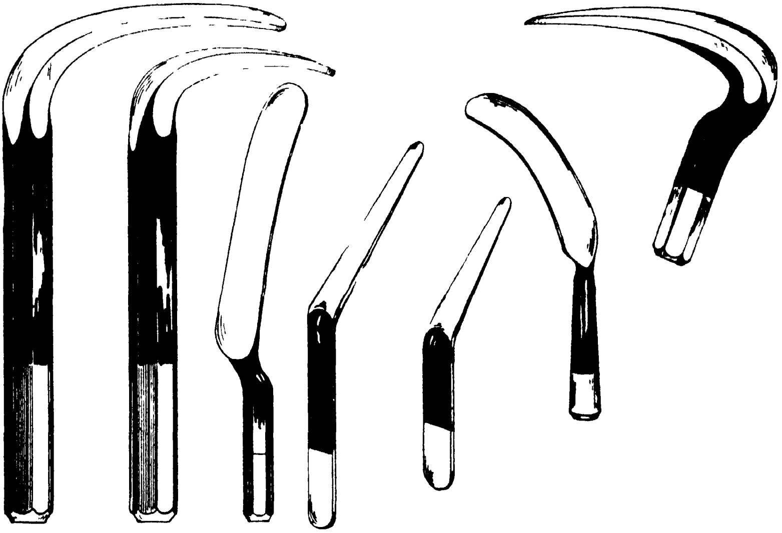


Fig. 30. Spoons, like dolly blocks, are a kind of hand anvil.

CHAPTER VI

FUNDAMENTALS OF METAL WORKING

It has already been mentioned that the successful body and fender man will be a **student** of his job. He will study the manner in which the damage was caused and then will devise ways of exerting pressure in the **opposite** direction to correct the damage.

"As it goes in so it must come out," is the plain and effective way a man with over twenty-five years of experience in this art of sheet metal working explains the whole repair process.

While body construction will receive more detailed consideration later in this book, it is well to point out here that there are three types of body construction: first, wood and steel; second, all steel; and third, wood and aluminum. The first type combines a wood frame covered with steel. While this metal is not heat-tempered, it is somewhat hard and has a spring effect.

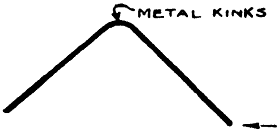


Fig. 31. Soft metal when bent tends to kink.

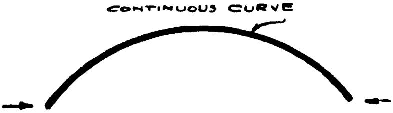


Fig. 32. Body metal tends to form an arc instead of kinking when bent.

If a flat strip of the ordinary sheet iron about 4 inches wide and 4 feet long is held at each end and bent in an attempt to form an arc, it will kink as shown in Fig. 31, and when released, the kink will tend to remain. In other words, this metal has very little life or temper.

A piece of body steel formed in the same manner will not kink but will bend in a continuous curve, as shown in Fig. 32, and will spring back to its original position upon release. This indicates the consistency of body steel and is mentioned here to emphasize that when a body or fender is dented, the metal is in a forced position, and if there are no sharp creases in the dented surface, the metal will spring back to its original position with just a little help of the right kind at the right place.

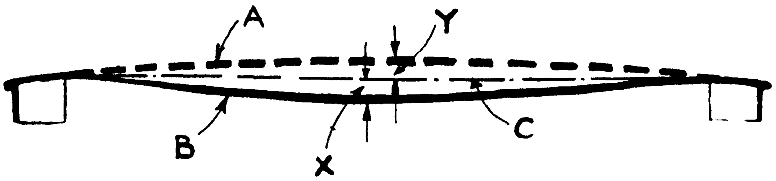


Fig. 33. A long expanse of body metal has considerable spring effect as seen here.

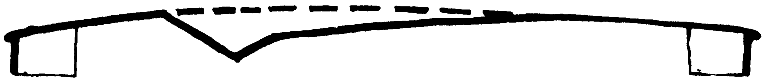


Fig. 34. Any body metal can be stretched out of shape by contact with sharp objects in a collision.

Body metal in its natural flat or slightly curved position such as a door panel, Fig. 33, is more flexible and has more spring effect than that which has been forced into a shorter and sometimes compound curved position, such as the rear corner of a body or top which has been formed with dies or as shown in Fig. 34, which was caused by collision.

During this bending or stretching process the grain or structure of the metal is disturbed which causes it to have a little different characteristic. In other words, it is stiffer and has less spring effect.

For example: Fig. 33 shows a door panel of which the entire surface was pushed in, but not far enough to cause a stretch, and no sharp creases were made in the dented surface. By lifting the upholstery to allow access to the back of the panel and then exerting a little pressure at one edge of the dent, the entire dented surface will spring out similar to the action of the bottom of an oil can when removing the thumb after pressing it. Only slight hammer and dolly work may be necessary around the rim of the dent.

Frequently the dented surface will be sharply creased in one or more places by striking or scraping some sharp object during the accident, as shown in Fig. 34. The metal may or may not be stretched at these creases; this will be determined after the usual smoothing processes. These creases will form stiffening ribs in the metal and prevent it from being easily returned to its original contour as in Fig. 33. However, pressure similar to that exerted in Fig. 33 will restore a portion of the original shape quickly, so that the creases may then be treated with hammers and dolly blocks. If the dent does not come out by the application of a reasonable amount of simple pressure, such as a push with the foot in the case of panels, or use of a C clamp on fenders or crowned surfaces, then the work is begun with the hammer, which operation is known as "roughing out," and is fully described later in this chapter. Care must be exercised in this roughing out operation to avoid hammering the metal out beyond its original curve as this stretches it.

Most body and fender surfaces are convex, or curved outward. The greater the curve, the farther the metal can be pushed in before it must stretch. For example: this curve *A* in Fig. 33 represents the form of a door panel. The line *B* indicates how far the metal can be pushed in before it begins to stretch. The line *C* is the chord of curve *A* and if dimension *X* does not exceed dimension *Y* then the dent can be pushed back to its original position (line *A*) without any shrinking. If the dent is deeper than line *B*, then the metal is stretched, and the shrinking method explained in chapter X should be used.

Body metal can also be stretched by continually striking it with a hammer while holding a dolly directly underneath the point of the hammer blow. It is necessary at times to be able to stretch this metal as well as to shrink it. Although this does not happen often, it is well to study and practice it. Frequently a beginner will stretch the metal unintentionally while trying to smooth out a dent. This difficulty can be overcome by practice.

While discussing stretched metal, a word of caution might be inserted here. Stretched metal requires shrinking and since shrinking is done with heat, it is well to remember that metal loses its temper or spring effect when heated to a cherry red. Therefore, it cannot be too strongly emphasized that heat should only be used when and where absolutely necessary.

Bumping and Dinging

Hammer and dolly work is the basic operation in refinishing bodies and fenders. This operation is the oldest part of sheet metal working, and is the nucleus around which other operations are built and elaborated to broaden this work into a complete service.

Hammer and dolly work may be conveniently divided into two broad classes: **roughing** and **finishing**, or as more technically known, **bumping** and **dinging**.

Bumping.—Bumping is the first step in hammer and dolly work. It is that of using one of the heavier or specially designed hammers (Figs. 22 and 28), to work out the larger or sharply creased dents while roughly shaping the metal back to approximately its original contour. The remaining smaller dents are left for the finishing and dinging operation, which is explained later.

Study carefully each job before the work is actually started to discover the most effective and simple way of working out the damaged surface. Remember, a few careless blows may require a lot of additional time to restore the damaged portion to its proper level.

No specific instructions can be given in this work, as there are no two dents alike, and each dent may require just a little different procedure depending upon condition and location.

Bumping is accomplished by working from the opposite side from which the dent was made. As a general rule, on badly damaged surfaces, the hammering is begun on the sharpest creases or deepest dents, holding a heavy dolly block on the rim of the dent. On broad shallow dents it is started at the edge, working toward the center. The object during this procedure is to always remove the greatest strain first with the least amount of hammering.

On large surfaces, such as door and body panels, after the upholstery has been removed, the dents can often be roughed out to a great extent by exerting pressure with the foot, body jack, or large "C" clamps.

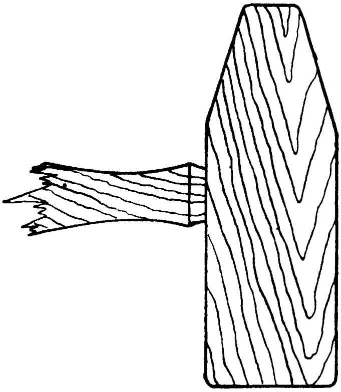


Fig. 35. Wooden mallet reduces chance of stretching metal when roughing it back to shape.

When the dent occurs directly over a fender bracket, body support, or in places too narrow to allow the use of a hammer, then one of the fender or body spoons can be used to pry the metal out, and later, as an anvil, while dinging.

Care must be exercised in this operation to avoid hammering or forcing the metal out beyond its original contour, as this stretches it. There are times, however, when the force of the blow that caused the dent was so great that the metal was stretched at the time of the accident. This condition, and the extent thereof, can best be determined after the usual bumping and dinging process is completed.

On badly damaged surfaces, after they are roughed out, it is sometimes advisable to rough ding them with the use of a wood, fibre, or rubber mallet and dolly. The mallet eliminates the danger of stretching the metal (Fig. 35).

Dinging.—The dinging operation is that of smoothing out the smaller dents remaining after the usual roughing out has been done. The principle is simply that of working metal on an anvil with a hammer, the anvil being the dolly block. Fig. 36 illustrates the dinging operation in its simplest form. Note carefully the position of the hammer in relation to the dolly block.

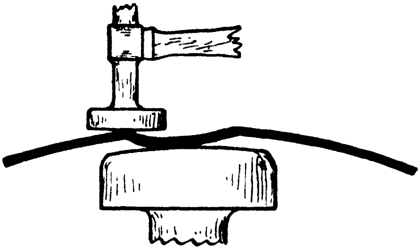


Fig. 36. Simple dinging. Note relationship of hammer and dolly block.

Before starting any hammer and dolly work, clean thoroughly, removing all mud, tar, grease, etc., from both sides of the metal. Use a scraper to clean the underside of fenders or inside of door or body panels. Tar can be removed from a lacquered surface without marring it by soaking it with kerosene oil or lard until dissolved. Any dirt sticking to the metal will scar the surface of the dolly or hammer. Using a scarred dolly or hammer will cause the body metal to become pitted, requiring more hammering and filing to secure a smooth finished surface.

A thin coat of motor oil on the painted surface of a fender or body panel will prevent marring it when striking with the hammer, and the gloss of the oil will tend to show up the defects in the surface, especially where the paint has become dull.

For the best and quickest results, place the job in a position so that the reflection of the light shows up the high and low spots.

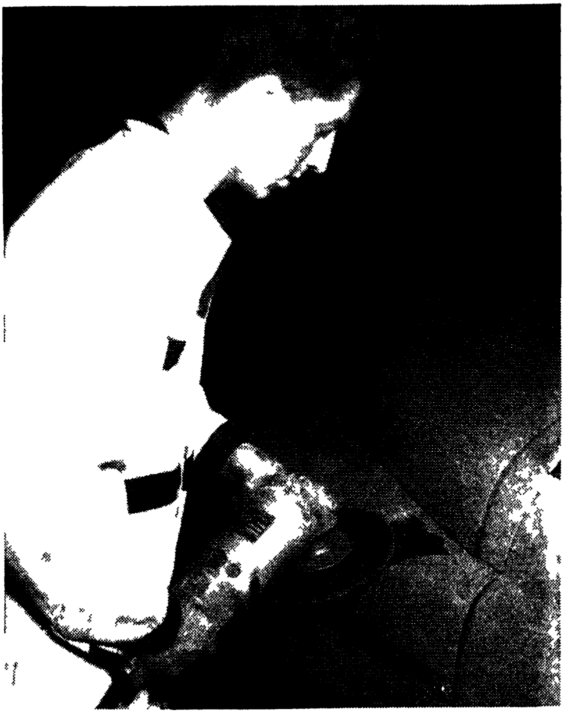


Fig 37 When all dents are out this disc sander removes the file marks

The dinging operation consists principally of repeatedly placing the dolly, as shown in Fig. 36, on the remaining low spots, and applying outward pressure, at the same time striking lightly with the hammer on the high spot or rim of the dent. The kind of dolly to use is governed by the location of the dent (see examples in Fig. 29). This procedure is continued until the surface appears to be smooth. Rubbing the hand lightly over the surface will reveal high or low places that are not noticeable to the eye. After dinging the metal as far as the sight or touch will permit, the body worker's file is brought into use. Drawing the file over the surface a few times will reveal any remaining defects which were not noticeable by the sight or touch, and which must be smoothed up with the hammer and dolly. Repeat this filing and dinging until there are no dark spots remaining; this will indicate that the surface is uniform. Use of a cloth or canvas glove on the hand will accentuate the "feel" of high and low spots.

Don't file away wrinkles or high spots. Remember the metal is not thick. Use the file only for showing up high and low spots; then use the hammer and dolly to level them out.

To complete the job the surface should be sanded to remove any rough nibs or scratches usually caused by filing. This is easily done if a portable electric sander is available, using a disk of No. 60 or 80 grit. If not, the smoothing can be done by hand with a piece of medium fine emery cloth, or sandpaper.

Remember that a coat of lacquer or enamel will not cover or hide any defects, but instead tends to magnify them.

CHAPTER VII

PRINCIPLES OF SOLDERING

A good soldering job is the mark of the good mechanic. Soldering is simple but has certain limitations and technical requirements.

First of all no soldered joint is strong. The main purpose of solder is that of filling up irregular places, smoothing rough surfaces, or making joints tight (Fig. 38).

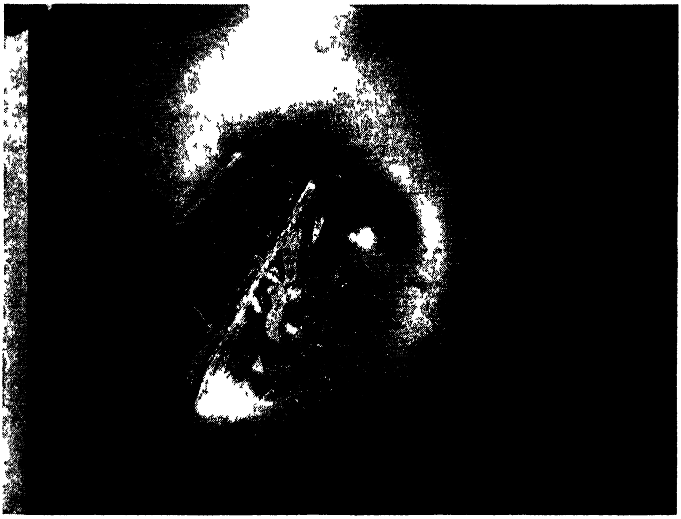


Fig. 38. Without removal of door trim, solder can fix this damage.

Perfectly clean metals are the foundation of all soldering. All paint, grease, and dirt must be removed by scraping, sanding, or filing (Fig. 39). If the solder is covering a break in the metal, then other means than the soldering must be provided to make the job strong. For example, the metal may be welded and the weld hammered down, and then the rough surface filled with solder and filed smooth. But never rely on solder for strength.

After the metal is clean and structural strength provided, a flux must be applied to remove any oxidation (Fig 40). Probably the most common flux is muriatic acid in which has been dissolved as much zinc as the acid can "eat up." There are numerous objections to this flux from the angle of injury to hands and lungs of the user, from the fact that stronger joints can be made with regular commercial flux, plus the nuisance of preparing this flux and its cost which approximates that of good commercial fluxes. Possibly the greatest objection to the muriatic acid flux, however, is the

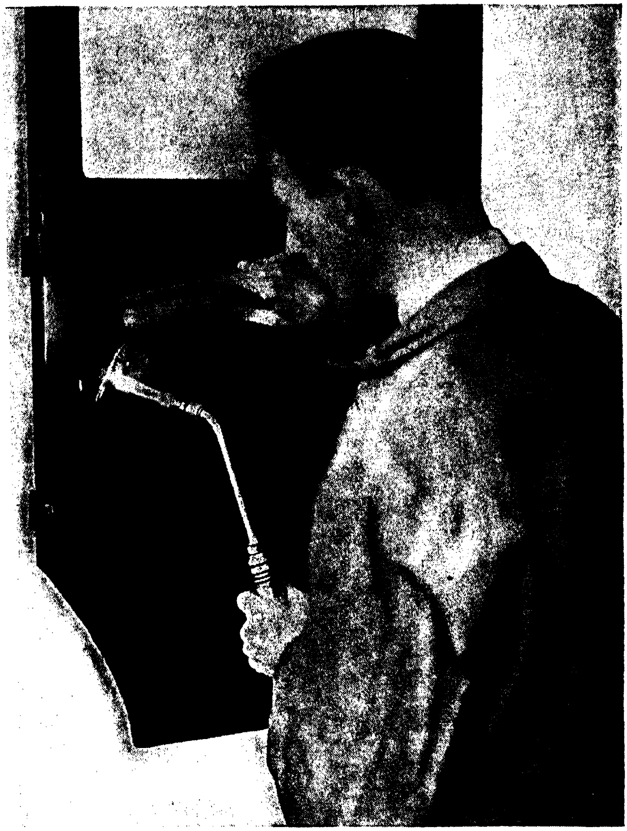


Fig. 39. Wire brush and torch remove paint, grease, and other dirt.

fact that it dries out on the job, and frequently this results in soldered seams in which this drying out prevented the solder from "floating" into the seams. Thus the job was weakened because the solder merely slicked over some of the places.

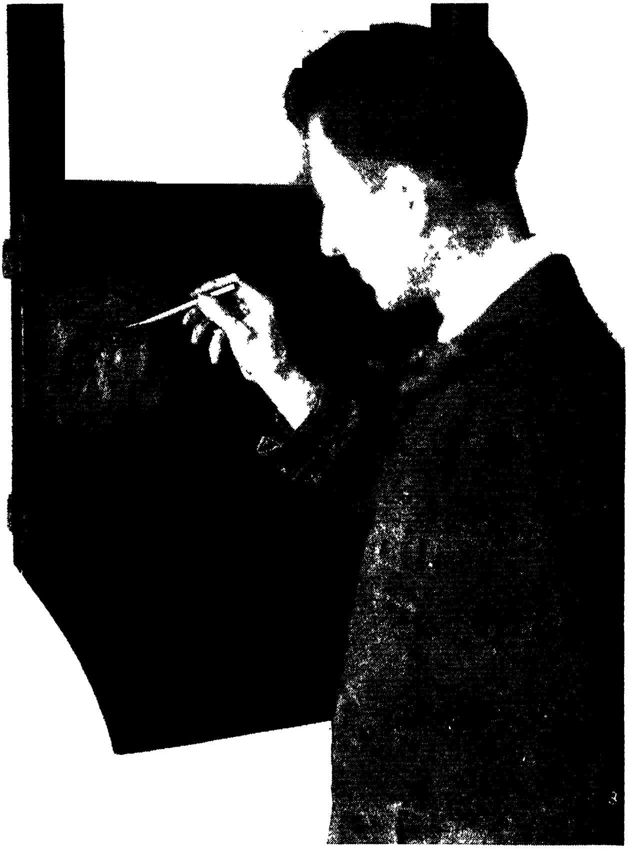


Fig. 40. Soldering flux is applied with a regular flux brush or swab.

Flux is generally applied with a dauber made of twisted wire and a tiny hunk of rag or with a regular soldering flux brush. The flux should be liberally smeared over the previously cleaned surface. Since heat accelerates all chemical action, the application of heat either with a **torch** (see Fig.

41) or with a **soldering iron** (really a soldering **copper**) will improve the cleaning action of the flux.

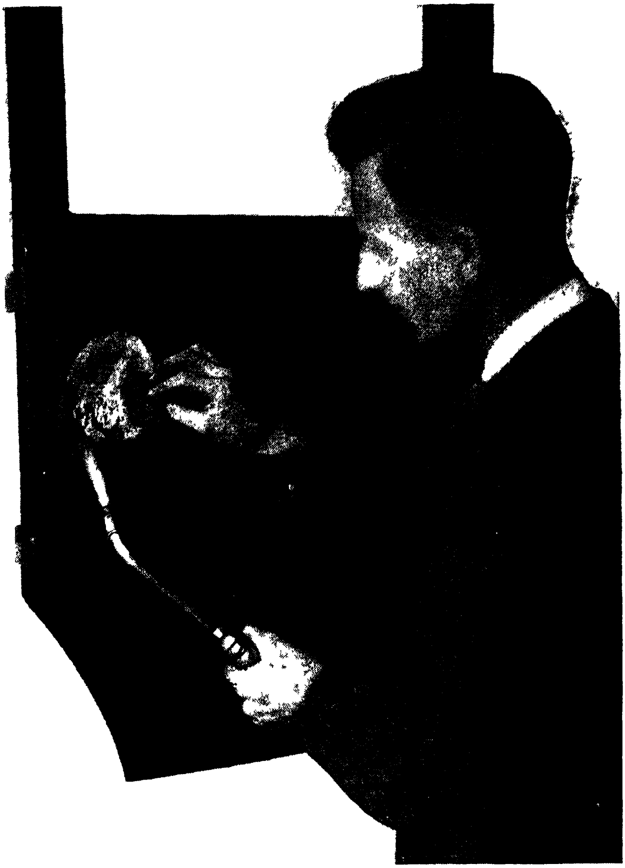


Fig. 41. Speeding the action of the flux by applying heat as the flux is rubbed with a pad of steel wool or a rag.

Tinning

With increased heat a little solder must be worked all over the surfaces which are to be soldered. This action is called tinning and provides the foundation of a really good soldering job (Fig. 42).

Some mechanics prefer to tin the edges of sheet metal before bolting them or riveting them together in order that the soldering job will be more perfect since, obviously, the tinning job just described cannot be done as effectively after parts are united. Then it will only be possible to apply plenty of flux and heat and watch to see if the solder seems to be flowing through to the far side from which it is being applied. If it does not do so, then additional flux and heat must be applied which may cause it to flow, provided the surfaces were thoroughly clean before being brought together.

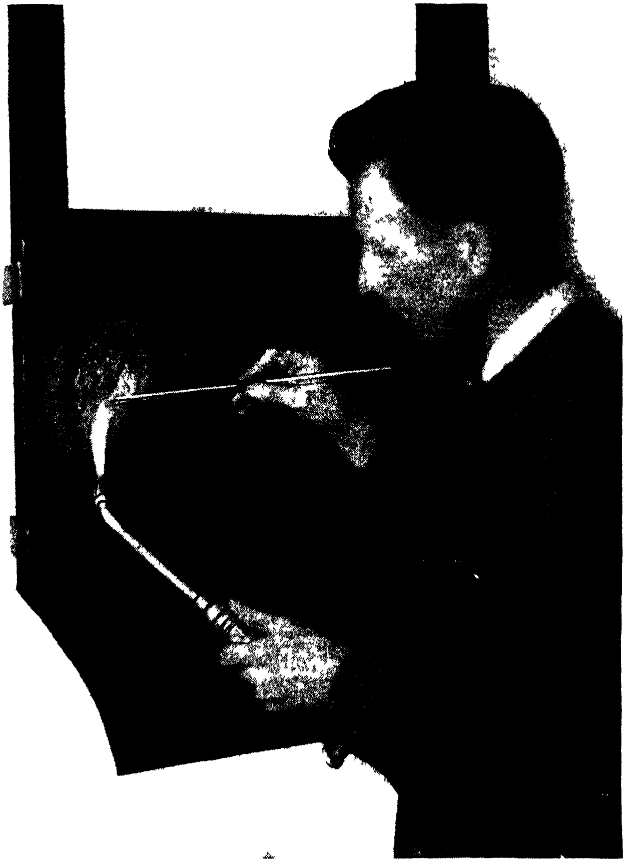


Fig. 42. Whether uniting two pieces of body metal or building up a damaged spot, tinning is necessary.

Methods of Application

Solder may be applied four ways: poured from a ladle, spread with a soldering iron, caused to flow with a torch, or sprayed on from a soldering gun. It will be appreciated that solder when applied is in a liquid state and hence soldering on horizontal work is far easier for the beginner than soldering on vertical or nearly vertical surfaces. Another point—when possible, always tip the work so the solder may flow into the joint.

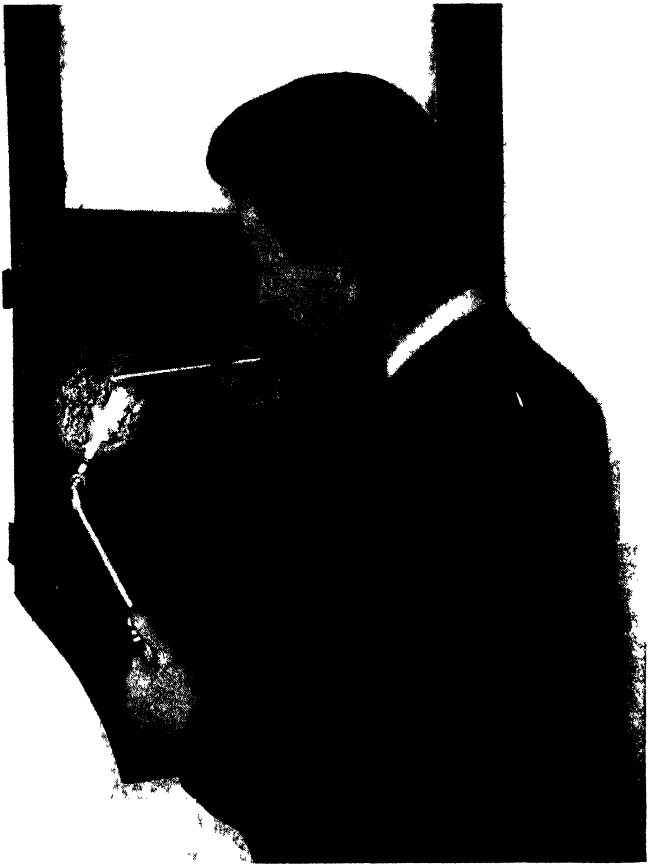


Fig. 43 Filling the dent by melting bar solder into the tinned surface with a torch.

A basic point in good soldering is to have the **work** hot enough so the solder flows onto the job. "Puttying" solder into place is a poor procedure when sealing joints, etc., its only place being when building up a low spot in a panel.

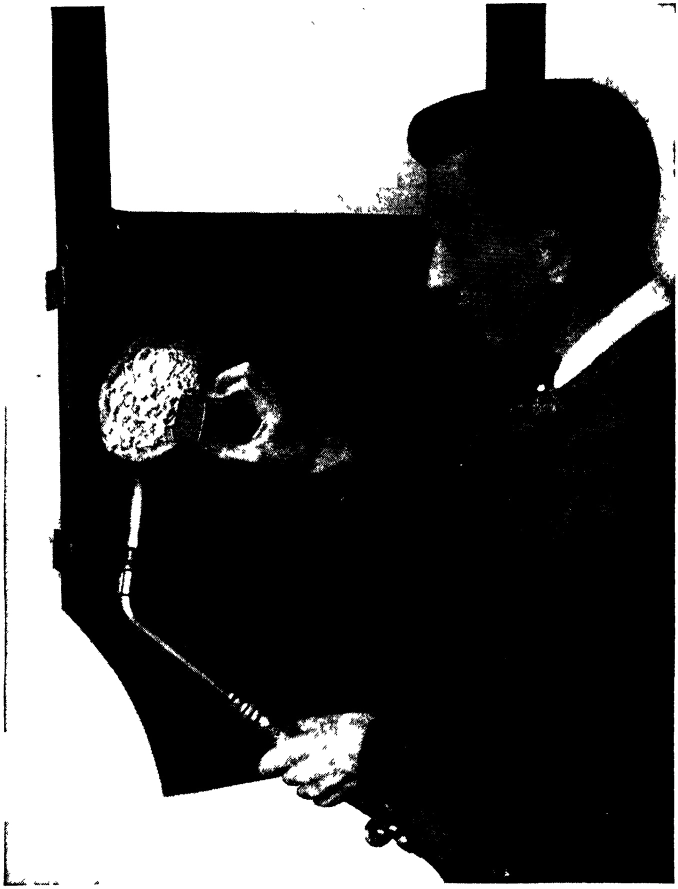


Fig. 44. Slicking solder smooth with wooden block and torch.

Then having the work hotter than the melting-point of the solder would cause the whole accumulation of solder to fall off.

Building up dents in panels may be done with solder which is just under the pouring point and which chills quickly when worked into position (Fig. 43). This paste-like solder mass is slicked smooth with a smooth block of wood which has been rubbed with beeswax (Figs. 44-45). The sheet metal and the wood combine to chill this solder mass and thus prevent flowing off the job. Surface slicking is then achieved with a torch and wood paddle, the torch softening the **surface** of the solder (look out for too much heat or the whole works will fall off) and the wood paddle smoothing it.

Fig. 45. Continued slicking minimizes the final filing and grinding and saves solder.

When using soldering irons the important point is to keep the tip clean and well tinned. Heating an iron too hot will burn the solder coating from the tip. The tip should be kept filed to a good point with sharp edges. Stroking the tip across a sal ammoniac block will remove scale, and then applying a little solder directly to the iron will keep the iron in good working order.

Solder Spraying

With the increasing interest in metal spraying guns, it is well to consider their possibilities and their use. The spraying of solder into dents which, because of difficulty in removing upholstery might otherwise be very costly to repair, is increasing in popularity with motorists and service men (Fig. 46).

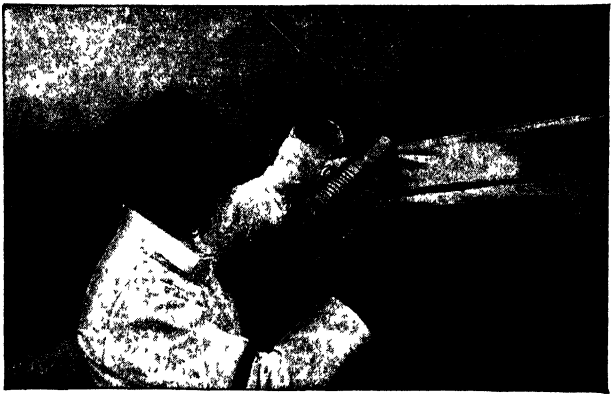


Fig. 46. Without disturbing headliner or other trim this dent is being repaired by metal spraying.

The gun here illustrated incorporates a number of improvements in this kind of equipment. The flow of current is automatically regulated in this metal sprayer to maintain the gun at the most efficient temperature. The heating element is large enough to enable continuous operation, yet the thermostat automatically prevents overheating; and fluctuation in line voltage does not affect its operation.

The following steps show how repairs are made by metal spraying:

1. Plug the spray gun into a proper electrical outlet and connect up the air line so as to obtain about 65 pounds per square inch pressure at the gun; then proceed as follows:

2. If the dent is deep, bump or pull metal as nearly back into place as practicable so as to reduce amount of necessary lead to a minimum.

3. Clean whole surface to be filled thoroughly with disk sander, wire brush, etc. Be sure that entire surface is down to bright metal and is free from oil or foreign matter.

4. Stir the Cold Tinning Compound (Fig. 47) thoroughly with a clean wooden paddle; then apply a small amount to the cleaned surface with this paddle.

Fig 47. Commercial soldering flux is available for every kind of soldering job.

5. Work compound over entire surface with a clean damp rag, supplying additional compound when necessary until bright lustrous surface appears under the compound.

6. Wipe excess compound away with a clean rag. Wipe from center of area toward outside so as not to bring dirt or oil on the surface from the uncleaned edges.

7. Place nozzle orifice on a flat surface and pull the air trigger. This diverts the air up through the solder well, blowing it out so that the solder will flow freely.

8. When gun is hot enough to spray, pull the air trigger back as far as possible, then feed a stick of solder (Fig. 48) down through the solder well (do not force it), and direct the spray straight (not at an angle) against the tinned

surface, holding tip of gun about 2 inches from work (Fig. 49).

9. First spray a light coat of solder over the entire tinned surface; then continue spraying until all of the low places have been built up slightly higher than the desired surface.

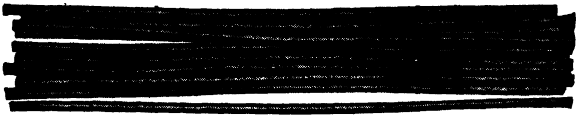


Fig. 48. Solder may be bought in large bars, as wire, or small bars such as the special body solder seen here.

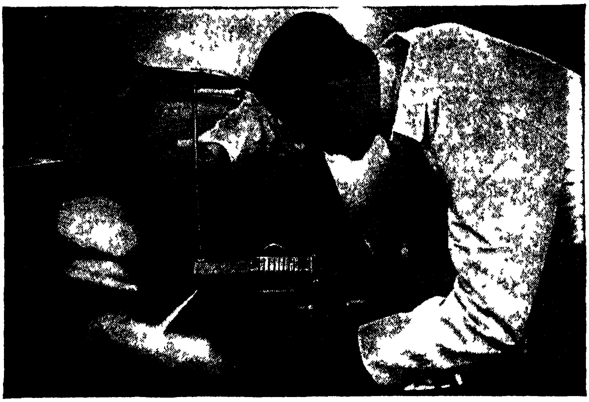


Fig. 49. Note that the operator causes the sprayed metal to strike the sheet metal at approximately right angles.

10. When spraying is stopped, even temporarily, remove solder stick and continue air full force until solder well is cleared of all molten solder. Then blow out well as explained in paragraph 7.

11. With a heavy sanding disk (No. 16 grit suggested) or a body rasp (Fig. 50), dress the lead down gradually to the desired surface. (Do not sand in one spot so long that the lead becomes heated.)

12. Smooth the surface with fine sandpaper and finish for painting (Figs. 51-52).

Spraying Over a Glazed Surface

Sprayed solder has a dull, gray appearance with a rough surface texture, and as long as this surface is maintained, additional solder can be sprayed on it. However, if this surface has been glazed by filing, sanding, or by heat, it is necessary to soften it with metallic mercury before sprayed solder will stick to it. This can be done as follows:

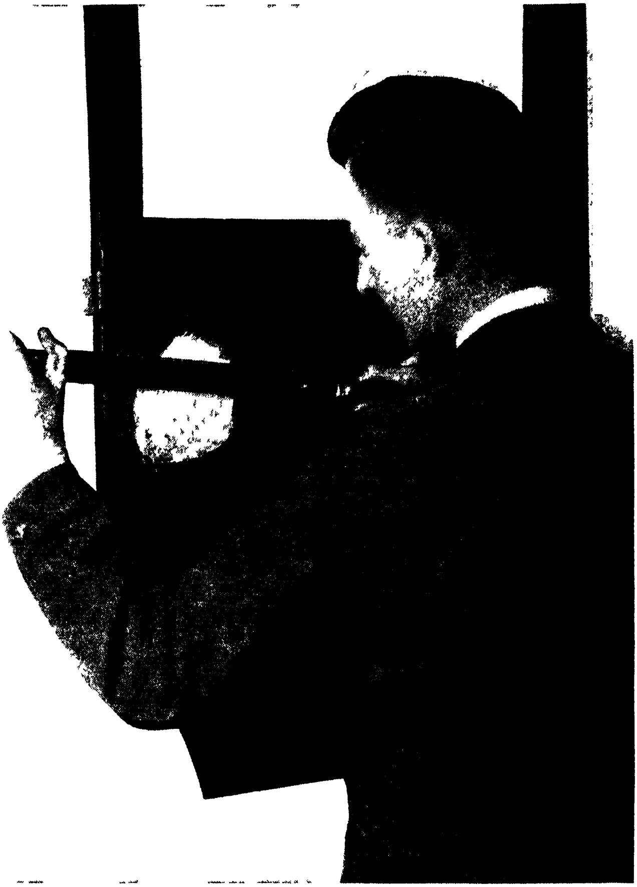


Fig. 50. Body rasp giving preliminary smoothing to soldered repair.

Place a few drops of metallic mercury (quick silver) on the glazed lead surface and rub it over the desired area with a clean rag. At first the lead will take on the appearance of a bright tin but this will gradually dull as the lead is softened. Increase the air pressure to 85 or 90 pounds, and proceed to spray in the usual manner.

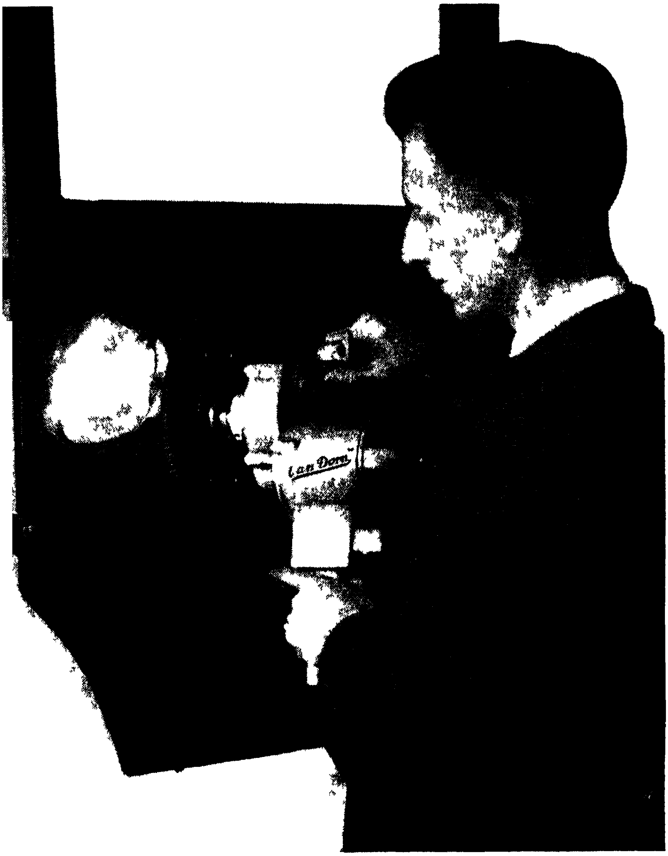


Fig 51 Final smoothing with motor-driven sander.

Quite often in sanding, the higher points of the lead will be sanded down to the desired level and low spots will appear which have not been touched by the sander. In such a case, the solder can be sprayed into these low spots without further treatment. Solder which penetrates the un glazed low spots will stick, whereas that which falls on the unsoftened glazed surface will come up upon sanding.

Filling Up Holes

In repairing holes or torn places in panels, gas tanks, etc., insert a small ball of steel wool in the hole just below the surface and fill and dress the dent in the regular manner.

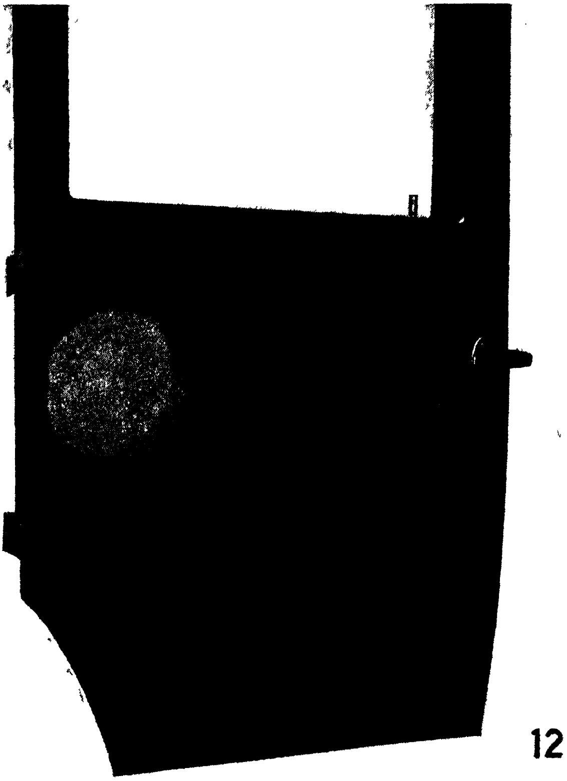


Fig. 52. The finished repair ready for painting.

Spraying on Aluminum

Aluminum surfaces are more difficult to tin than steel, so that more compound must be used and it will be necessary to rub the compound more vigorously. At first the surface will turn black, but upon continued rubbing and application of the compound, the black residue will be wiped away and a bright tin obtained. Solder can now be sprayed on in the regular manner.

CHAPTER VIII

USE OF OXYACETYLENE WELDING

No body shop can be considered completely equipped without facilities for oxyacetylene welding.

Not only will this equipment prove indispensable for welding and cutting, but it will be used for shrinking metal and for straightening or bending pieces that cannot be bent cold. Because of the importance of welding in any body or fender work, complete instructions in setting up and using typical equipment is here given. The remarks that follow cover specifically the portable Airco-Davis-Bournonville equipment but apply in general to any other similar equipment though each manufacturer issues specific instructions on his own products.

A portable Airco-Davis-Bournonville welding outfit comprises a welding torch with separable tips, mixing head, length of green oxygen hose, length of red acetylene hose, and pressure regulators. Airco oxygen and acetylene are the recommended gases. A portable outfit should also include a two-wheel cylinder hand truck with chains to secure the cylinders in place. The truck provides for easy transport, and in a measure protects the apparatus from damage. A cutting outfit is similar but has a cutting torch and tips in addition (Fig. 53).

The methods of assembling the torch, hose lengths, pressure regulators and sources of gas supply, turning on the gases, adjusting the working pressures, lighting the torch, adjusting the flame and shutting down, have a highly important bearing on the success of the oxyacetylene welder. These are stressed in the following pages.

Written instructions on the technique of welding and cutting are necessarily incomplete. The beginner will profit by personal instruction, practice, and friendly criticism in acquiring the ability to make strong, sound welds at reasonable speed. Although cutting is more quickly learned than welding, the cutting operator also needs to follow approved practice in setting up, lighting, and shutting down (Fig. 54). He should train to conserve oxygen, which means holding the torch steadily, moving it uniformly forward and using the smallest tips and lowest oxygen pressures consistent with the thicknesses cut. Here also some personal instruction, as well as practice, is necessary to acquire skill.

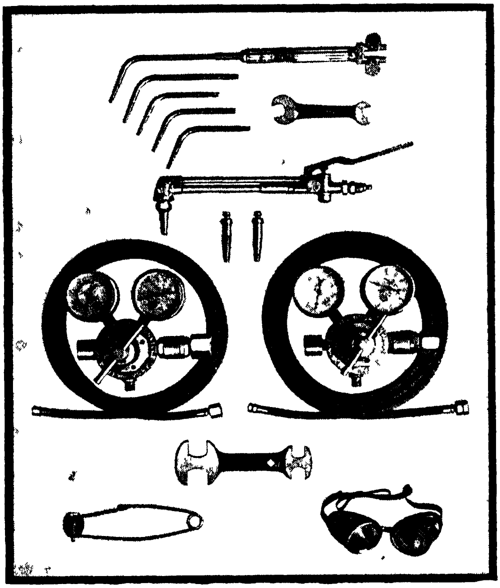


Fig. 53. A complete welding and cutting outfit less tanks and truck.

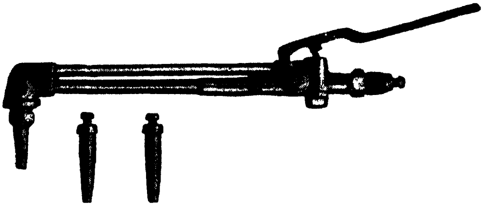


Fig. 54. A cutting torch with extra tips.

All common commercial metals are readily fused with the oxyacetylene flame, and practically all can be welded. The list includes wrought iron, steel, steel castings, alloy steels, gray and white cast iron, aluminum, copper, brass, bronze, nickel, monel, the principal commercial alloys, the precious and the semi-precious metals. Welding dissimilar metals to each other, such as steel and cast iron, steel and copper, is also practicable.

The filling material or welding rod as a rule should be of nearly the same chemical composition and physical characteristics as the base metal. Low-carbon steel is generally welded with low-carbon rods, cast iron with cast-iron rods, copper with copper rods, and so on. When welding dissimilar metals the welding rod as a rule is of the metal having the lower melting-point. Thus copper rods are used when welding steel and copper.

The pressures of the gases in the cylinders are too high to be used directly for welding, and are reduced, as they flow through the pressure regulators, to the working pressure required in the torch. The pressures for welding range from 1 pound to 20 pounds per square inch for the oxygen, and from 1 pound to 12 pounds for the acetylene, depending on the tip size, torch type, and thickness of the metal.

The oxyacetylene hand-welding torch is a tool for mixing oxygen and acetylene in nearly equal volumes and burning the mixture at the end of a tip, the object being the fusing of metals for welding.

The Airco-Davis-Bournonville Style 9800 welding torch (Fig. 55), approved by the Underwriters Laboratories, is comprised of a brass handle, a rear end to which are attached the oxygen and acetylene needle valves, oxygen and acetylene tubes inside the handle, joining the rear end to the torch head, mixing head nut, mixing head, and tapered copper welding tip.

The needle valves of improved compact construction provide ample packing space for the stems and good grip for the fingers when wearing gloves. Hose connections for 5/16-inch inside diameter hose are of the approved standard design now in general use on all makes of torches. The oxygen hose thread is right-hand, and the acetylene hose thread left-hand. The needle valves screwed into the rear end are soft soldered in place to insure tightness and permanent position.

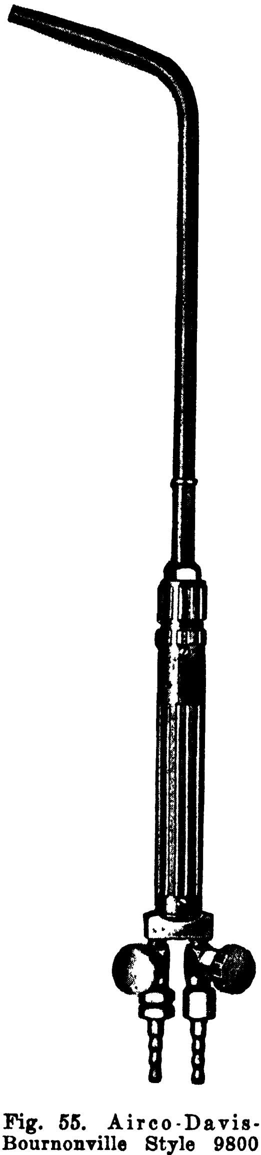


Fig. 55. Airco-Davis-Bournonville Style 9800 welding torch.

The seamless brass gas tubes inside the handle are silver soldered to the rear end and torch head.

The tips, made of seamless copper tapered, are bent to the welding angle, 67½ degrees, and threaded at the rear to fit the mixing head. The end of the tip makes up against a flat seat in the mixing head, which construction is well removed from the welding heat and which insures against leaks.

Special hose fittings are provided for attachment to the torch and pressure regulators. In making up hose with these connections for the torch and regulators, care should be taken to use the oxygen fittings in the oxygen hose and the acetylene fittings in the acetylene; fittings are not interchangeable; each must be connected to its respective pressure regulator and torch needle valve.

The oxygen and acetylene hose lengths are made of distinctive colors and are fitted with non-interchangeable connections to prevent mistakes in setting up.

The hose lengths should be firmly secured to the fitting with two wire loops around the hose. Use of a thin coat of shellac on the fittings is recommended. The wire loops may be covered with adhesive tape.

Oxygen and Acetylene Pressure Regulators

The function of the pressure regulator is to reduce the pressure of the gas flowing from the cylinder to the required working pressure in the torch, and to regulate the flow volume. Airco-Davis-Bournonville oxygen welding regulators have a 3000-pound high-pressure gauge and a 50-pound working-pressure gauge (Fig. 56). The high-pressure 3000-pound gauge indicates the pressure in the oxygen cylinder. The working pressure, adjusted by turning the regulator adjusting screw in the front of the case, is indicated on the working-pressure gauge, graduated to 50 pounds. A safety disk is provided to relieve over-pressure beneath the diaphragm. Should the safety disk be blown by a leaky seat or over-pressure due to any cause, the defect should be rectified, and the safety replaced only by a standard disk.

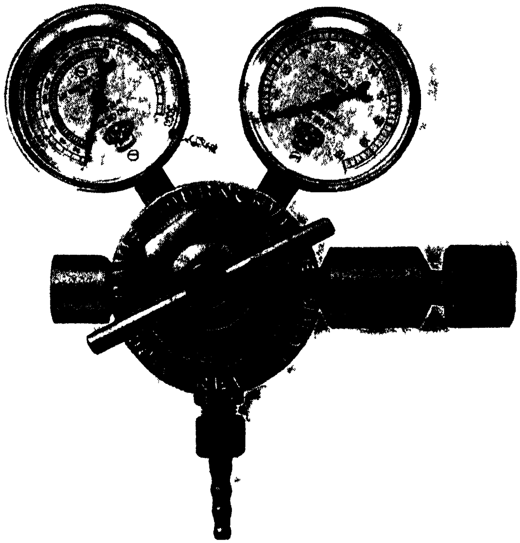


Fig 56 Oxygen regulator with 3000 pound high pressure gauge and 50 pound working pressure gauge.

The inlet connecting the regulator to the oxygen cylinder contains a special filter to prevent ingress of scale and other foreign substances injurious to the working parts.

The valve seating on the inlet nozzle is readily accessible for replacement. Removal of a screw cap in the back of the case uncovers the stirrup cap, equalizing pin and seat holder.

The Airco-Davis-Bournonville acetylene pressure regulator is of the same design as the oxygen regulator, differing only in the graduations of the gauges and certain details. The high-pressure gauge, indicating the pressure in the acetylene cylinder, is graduated to 400 pounds, and the working-pressure gauge to 30 pounds (Fig. 57). The acetylene regulator is provided with a safety disk to relieve overpressure beneath the diaphragm.

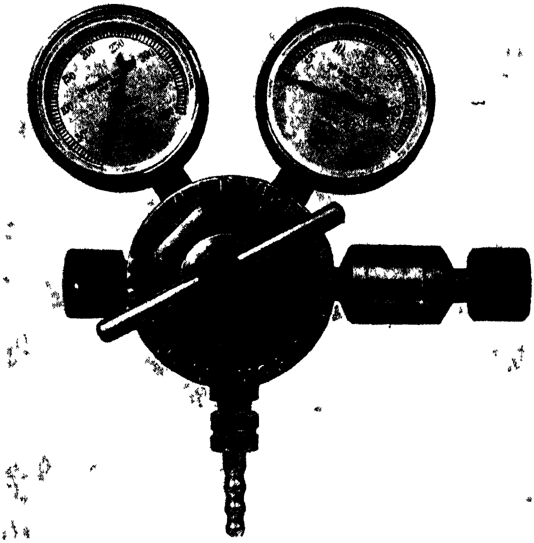


Fig 57 Acetylene regulator with 400 pound high pressure gauge and 30 pound working-pressure gauge.

Worn valve seats are readily replaced by removing the screw cap in the back, taking out the stirrup cap screw and the equalizing pin. The new seat is dropped into place and the equalizing pin placed behind it, taking care that it is properly positioned. The stirrup cap is replaced and the screw plug, with a copper gasket under the shoulder, is screwed tightly in place.

Airco standard oxygen cylinders contain 220 cubic feet of free oxygen when under initial pressure of 2000 pounds per square inch at 70° F. The small Airco oxygen cylinder contains 110 cubic feet of free oxygen.

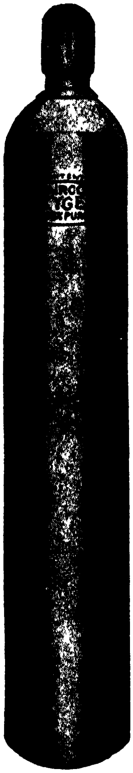


Fig. 58. Oxygen cylinder.

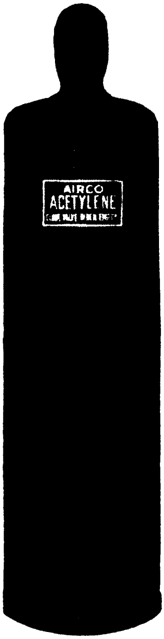


Fig. 59. Acetylene cylinder.

Airco oxygen cylinders are made of drawn steel without seams and are tested by hydraulic pressure to 3360 pounds per square inch when manufactured, and periodically thereafter (Fig. 58). Each cylinder is stamped with a number for identification, and is equipped with a high-pressure valve and valve protector cap. A frangible disk and fusible plug assembly in the cylinder valve is designed to relieve the cylinder of its contents in case it is subjected to over-heating or excessive pressure from any cause.

The valve protector cap must always accompany the cylinder, and be screwed in place when shipped, to protect the valve from damage. This is a highly important requirement in the interest of safety, and should be scrupulously observed by all concerned in any way with the handling and transport of oxygen or other gases under pressure. They should also observe the rules prescribed for handling oxygen cylinders, and especially avoid rough handling and use of oil, grease, or other readily oxidizing substances on the connections. Care should be taken to avoid exposure to furnace heat, fires, and sparks from torches.

Airco acetylene cylinders for industrial use are known as Nos. 4 and 5 (Fig. 59). The No. 4 cylinder contains approximately 125 cubic feet of free acetylene under initial pressure of 250 pounds per square inch, at 70° F. The No. 5 Airco acetylene cylinder contains approximately 270 cubic feet of free acetylene.

Acetylene cylinders are closely packed with an absorbent filler. The packing is saturated with acetone, and the compressed acetylene is dissolved in the acetone. The design and construction are such as to preclude the possibility of voids and collection of appreciable volume of undissolved acetylene under high pressure.

Airco acetylene cylinders are fitted with high-pressure valve, the cylinder is stamped with an identification number, and this number should be reported to the shipper in all cases where a cylinder is damaged or found to be in a leaky condition.

The key or wrench controlling the acetylene cylinder valve should be left on the valve stem when operating. Each operator should have his own acetylene cylinder key or apparatus wrench with square opening for the acetylene valve. The valve should be opened one full turn when discharging gas.

Acetylene cylinders require special care as regards handling, exposure to heat, flying sparks, and position when in use. They should be handled carefully and never be bumped or dropped from trucks. They should be stored upright in a cool place under cover away from furnaces, steam pipes, or other sources of heat.

It is not good practice to bring an acetylene cylinder into the shop during cold weather and start drawing off gas before it warms up. Cylinders needed for the day's work should be stored in a moderately warm room the night before in order to get the best results.

Cylinder caps must be replaced when the cylinders are discharged. Always close the valves of empty acetylene cylinders. This is a highly important requirement to prevent discharge of free acetylene and acetone during shipment.

A highly useful if not indispensable accessory for welding and cutting is the sparklighter. It provides convenient and instant means for lighting the torch. Use of matches for lighting the torch should be generally avoided. The puff of flame produced by the ignition of acetylene flowing from the tip is likely to burn the hand if not protected by gloves. An Airco round file sparklighter furnishes a convenient, safe and effective means of torch ignition under every condition of use, and should be a part of every operator's outfit.

Goggles fitted with colored lenses that exclude harmful heat and the ultra-violet and infra-red rays should be worn by operators when using welding and cutting torches (Fig. 60). The colored lenses should be chosen to fit users individually, being neither too dark for efficient work nor so clear as to afford inadequate eye protection. The cups should fit the eye sockets closely to exclude flying sparks and globules of hot metal. Operators should not interchange goggles, because of individual fitting and for sanitary reasons.

The use of inferior or unsuitable welding rods has caused much trouble and loss. It slows up welding and is likely to produce weak and brittle welds. Commercial wire, such as used for fences and other common purposes, is unfit for welding. It is generally high in impurities—sulphur, phosphorous, and absorbed gases. Even though commercial wire might be found by analysis to contain quantities of carbon, sulphur, and phosphorous substantially in agreement with the American Welding Society specifications, it still may not be, and probably is not, of good weldability.

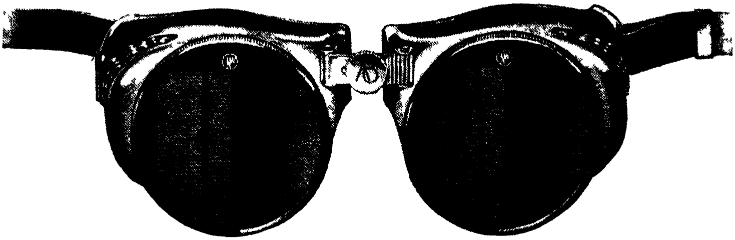


Fig. 60. Welding goggles to protect eyes against splattered metal and harmful rays.

A test for weldability of rods is easily made with the oxyacetylene torch. The rod sample is laid horizontally and partly fused. Its behavior under the flame and appearance after fusion determines its weldability.

The test should be made with a No. 1 tip and a strictly neutral flame. Fusion should penetrate to about one-half the diameter of the rod.

A rod of good weldability will have a surface after this test is made somewhat like that of narrow ripple weld. The metal will have been displaced into smooth blended drops, one merging into another, and none extending much beyond the original rod diameter. There will be a little sparking during fusion, and no pinholes in fused metal after cooling.

A rod of poor weldability will spark excessively during fusion, and the fused metal will spread irregularly, giving evidence of gas inclusions. The fused surface after cooling will be rough and irregular with some pinholes; the metal may have a spongy or "bread crust" characteristic in spots.

Ordinary commercial wire costs perhaps only one-third the price charged for welding rods. This differential is sometimes made a reason for the practice of false economy. The saving in the cost of rod is swallowed up in the loss of production and increased gas consumption, to say nothing of the inferior quality of the welds made.

The highest grade cast-iron welding rods should be used in welding gray iron castings. Ordinary foundry irons are unfit for this purpose. Their use is very likely to result in hard, brittle welds, weak and unmachinable. A good cast-iron welding rod is high in silicon and low in sulphur and phosphorous. With such cast-iron welding rods, a suitable flux, and proper preheat, the experienced welder should have no difficulty in making soft, machinable welds on iron castings.

The same advice applies to welding rods and fluxes for the non-ferrous metals and their alloys, such as copper, brass, bronze, and aluminum.

Welding Rods

Although the most of the welding done is on low-carbon steel with low-carbon welding rod, it is important that the welder know when to use other rods and what to specify when the need arises. The following list of drawn and cast welding rods covers general requirements of commercial, manufacturing, and repair welding.

Airco No. 7 Mild Steel Rods—An excellent rod at low cost for general use in oxyacetylene welding of steel plates, sheets, structural steel, pipe, etc., conforming to American Welding Society Specification G-No. 1A.

Airco No. 9 Cast Iron Rods—For welding gray iron castings, and making clean, sound soft welds that can be readily machined.

Airco No. 20 Bronze Rods—For general bronze welding and brazing malleable and gray iron castings.

Airco No. 22 Drawn Manganese Bronze Rods—For building up bronze surfaces on cast iron and steel as well as bronze castings where subjected to wear.

Airco No. 24 Cast Silicon-Aluminum Alloy Rods—For welding automobile crankcases and all aluminum castings.

Airco No. 25 Drawn Aluminum Rods and Wire—For welding sheet aluminum and all rolled and drawn aluminum products.

Airco No. 5 Nickel Steel Rods—A nickel alloy for welding nickel steel and other alloy steels when still higher strength than that given by Airco Vanadium rods is required.

Airco No. 2 Vanadium Steel Rods—For all welding requiring higher strength than afforded by low-carbon rods.

Airco Simplex Rods—Especially developed to produce high tensile strength welds in low-carbon or high-carbon steel plate, pipe, etc. An approved rod for pipeline welding.

Airco No. 6 Chrome-Vanadium Steel Rods—For wear-resisting and special strength welds in steel.

Airco No. 23 Drawn Copper Rods—Practically pure copper for welding rolled, drawn, or cast copper products.

Users of oxyacetylene torches should properly protect their hands against contact and radiation burns. Gauntlet gloves are recommended to provide protection for the wrists. The material should be wear-resisting and not easily burned (Fig. 61). Cotton fabric gloves, untreated, are dangerous and should never be worn when welding or cutting. The best welders' gloves are made of first quality horse-hide. Asbestos gloves are used in welding heavy preheated jobs and cutting risers from hot steel castings.

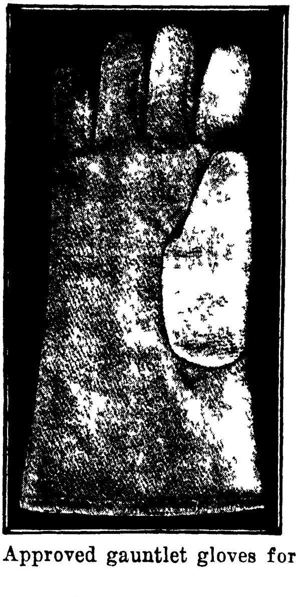


Fig. 61. Approved gauntlet gloves for welding.

Fluxes are used in welding cast iron, brass, bronze, aluminum, nickel, monel, and the non-ferrous alloys in general, but are rarely or never required in welding low-carbon steel.

A flux is essentially a deoxidizer. Low-carbon steel requires no flux because the oxide sometimes produced in welding remains in a molten condition.

But cast iron and the non-ferrous metals are welded at lower temperatures, and their oxides as a rule remain solid and tend to mix with the molten metal. Hence, the desira-ability of cleansing the metal with approved flux.

Airco-Atlas Cast Iron Flux is recommended for welding cast iron, and Airco-Marvel Welding and Brazing Flux, for welding brass, bronze, and copper and for brazing cast iron, malleable iron, and steel; Airco-Matchless Plate and Cast Aluminum Flux for aluminum plates and castings; and Airco-Napolitan Sheet Aluminum Flux for sheet and cast aluminum and many aluminum alloys.

The mechanical or physical properties of fluxes are important as well as their chemical properties. Intimate mix, proper proportions, and purity are essential to the best results. Fluxes should be kept in closed containers when not in use and should as a rule be used sparingly for the best results.

Special asbestos paper is used to cover castings when being preheated and welded, and while cooling down. Asbestos being an excellent non-conductor reduces the heat radiation and protects the operator; it shields the cooling casting from drafts and prevents rapid local cooling with consequent contraction stresses and danger of cracking.

The fragments of used asbestos paper make excellent packing for annealing steel forgings, dies, and tools.

Carbon blocks and rods are indispensable in building up shapes such as gear teeth, lugs and bosses on castings, and to protect threads in tapped holes. Carbon blocks and rods withstand the high temperature of the oxyacetylene flame. They are readily sawed and shaped with tools to any form required, and rods of correct diameter can be screwed into tapped holes, thus giving full thread protection.

The operator should dress in appropriate clothing for welding. A one-piece loose-fitting overall suit with button wristbands and close-fitting collar is recommended. Gauntlet gloves of good quality properly fitted and extending 2 or 3 inches above the wrists protect the hands and forearms from the heat. High, laced shoes with thick soles and sound uppers are desirable to prevent burns from flying sparks and molten metal. Head covering is optional. Many welders wear a thin cloth cap, and turn the visor backward in a measure to protect the neck. The goggles and sparklighter have already been mentioned as highly desirable if not indispensable parts of the welder's costume and outfit.

Suitable wrenches for setting up regulator nuts, connecting hose and changing torch tips are necessary parts of every operator's equipment. Use of pipe wrenches and unsuitable screw wrenches should be prohibited. High-grade small screw wrenches are permissible, but drop-forged wrenches with openings closely fitting the regulator nuts and hose connections are recommended. If loose-fitting wrenches are employed the nuts will be damaged, soon making the equipment unsightly and possibly requiring replacements.

The cylinders of welding and cutting outfits should wherever possible be used in an upright position to protect the regulators and to insure the best results as regards quality of acetylene and convenience of operation. A two-wheel truck especially designed to carry an oxygen and an acetylene cylinder is desirable with all portable outfits. The truck has chains for holding the cylinders in place.

The beginner should practice setting up and connecting the torch, hose, and regulators in a certain order. The sequence of operations following is recommended because it follows a logical order, assures safety, and eliminates unnecessary movements.

Roll the cylinders on to the truck and chain them fast. Remove the valve caps and examine the screw threads on the outlet nozzles. Do not attempt to use a badly bruised screw thread or connection seat. A damaged thread is likely to spoil the regulator nut, and a jammed seat will leak. Damaged valves are a result of leaving off the valve caps in transit, and the damage generally happens after the cylinders have been turned over to the user. Co-operation to prevent damage to cylinders is always to the user's benefit.

General

1. Do not use oil or grease on cylinder valves, regulators, or torches.
2. Do not light torch with both torch valves open.
3. Do not use leaking or damaged apparatus. If a cylinder valve leaks, take the cylinder out of the shop and notify the shipper at once. If torches or regulators leak, have them repaired and tested by the manufacturer. If the hose leaks, immediately exchange it for good hose.
4. Keep hose from kinking, free of obstructions, and do not use excessive hose lengths.
5. Keep the torch flame and sparks away from hose, regulators, and cylinders. Keep hose away from heated metal.
6. Close cylinder valves when not in actual use.
7. Do not tighten the regulator adjusting screw to the limit in order to bleed the cylinders.
8. Regulator adjusting screws should be released when not in use.

Starting

1. Open cylinder valves slowly, to blow out any dirt before connecting regulators to valves, then close valves.
2. Connect regulators to cylinder valves, with regulator adjusting screw released; make sure that connection seats are clean, free from grease or bruises before connecting. Set the connecting nuts up tightly with the proper wrench and carefully avoid crossing threads.
3. Open acetylene cylinder valve one full turn; open the oxygen cylinder valve slowly, full open.
4. Connect hose to regulators and blow out hose with gas to free it from dust or dirt before connecting to torch,

by turning in regulator adjusting screw, then releasing screw to close regulator.

5. Connect torch to hose. Standard oxygen connections have right-hand threads, acetylene connections, left-hand threads. Set nuts up tightly with proper wrench, making sure that connecting seats are clean and free from bruises to avoid leaks.

6. Use only tips that have clean seats, free from bruises. A bruised or dented tip makes a leaky seat and scores the torch head, making repairs necessary. Using a larger size tip than necessary wastes gas and is likely to result in poor work.

7. Open torch acetylene needle valve, with the oxygen valve closed; turn in acetylene regulator adjusting screw until the low-pressure gauge registers the desired working pressure; close acetylene needle valve.

8. Open acetylene needle valve and light torch with spark-lighter; open oxygen needle valve and adjust for neutral welding flame.

9. Set the working pressures at the regulators slightly higher than required tip pressures, and adjust flame with torch needle valves; this is done to avoid frequent readjustment of the regulators to compensate for falling pressures.

Stopping

1. Close acetylene valve on torch first.
2. Close oxygen valve on torch.
3. Close acetylene cylinder valve.
4. Close oxygen cylinder valve.
5. Open torch acetylene valve, with oxygen valve closed, to drain the line; release the adjusting screw on the acetylene regulator, then promptly close torch acetylene valve.
6. Open torch oxygen valve, with acetylene valve closed, to drain the line; release the adjusting screw of the oxygen regulator, then promptly close torch oxygen valve.
7. Flashbacks result from mixed gases in either oxygen or acetylene hose. By following these rules acetylene will

not get over into the oxygen line nor oxygen into the acetylene line when starting or shutting down. If torch flame is properly adjusted and maintained, with correct pressures and tip outlets kept free from obstruction in operating, flashbacks will be eliminated.

8. Remove regulators when moving cylinders unless on hand truck. Replace caps over cylinder valves when cylinders are empty, and mark cylinders "MT."

When new apparatus is set up for the first time it is advisable to test for leaks in the hose and all connections. Leaky apparatus must not be tolerated. Leaks mean wasted gas and danger of fire. The beginning operator is advised to make this test to acquaint himself with the method and to determine for himself that he has made the proper connections and screw them up to the required tightness. Never test for leaks with a flame.

The approved method of testing for leaks is to apply soapsuds to all connections with a small brush. The presence of a leak will be disclosed by bubbles forming. The remedy is to apply more pressure with the wrench, or if already tightened to a reasonable degree, to shut off the gas pressure and open the connection to see what the difficulty is. A slight scratch or bruise or foreign substance may be found. Rub the bruised surface with fine emery cloth, or if caused by foreign substance, remove it and reconnect. Turn on the gas pressure and test again.

Inferior and old hose often is porous, and leaks may be found in the hose itself. The remedy for this condition is to cut out the porous section, and join the pieces with a hose connector, or better still replace the hose with hose of reliable make.

The Oxyacetylene Cutting Process and Apparatus

Cutting with the torch is the process of burning metal with oxygen to effect separation. Wrought iron, steel, and cast iron are the metals cut by this process. Aluminum, brass, bronze, nickel, monel, and the other non-ferrous metals and alloys cannot at present be cut by the torch process.

In oxyacetylene cutting of iron, steel, and cast iron, the metal is heated to the ignition temperature with preheating flames burning at the end of the tip. The preheating flames, usually four, are spaced around the cutting orifice in the center of the tip. When the metal to be cut is heated to a bright red the high-pressure oxygen jet is turned on, and the metal in the path is cut or burned away (Fig. 62). Progressive movement of the torch results in cutting a narrow kerf similar to that made by a metal saw. Acetylene is the preferable fuel gas for the preheating flame, and oxygen is required both to burn the acetylene in the preheating flames and to effect cutting.

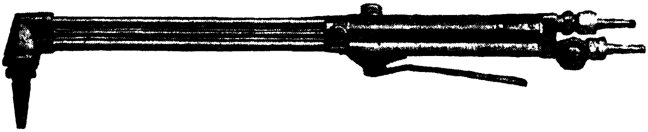


Fig. 62. Cutting torch with preheating flames surrounding the centrally located oxygen orifice.

Growth of the oxyacetylene industry is reflected in the demand for a combination welding and cutting outfit adaptable to the needs of small shops, garages, plumbing and heating contractors, steam pipe fitters, and others occasionally requiring a cutting outfit but whose main activity with the torch is welding.

The Airco-Davis-Bournonville combination welding and cutting outfit No. 9898 comprises the Style 9800 torch with tips, regulators, hose, wrenches, goggles, sparklighter, and style 7790 cutting attachment (Fig. 53).

In making up the cutting attachment with the torch handle the operator should grasp the rear end with his hand over the needle valves while applying wrench pressure. It is essential that the swivel nut be firmly tightened to prevent leaks and backfires.

The oxygen welding regulator is adaptable to cutting with this attachment inasmuch as the oxygen pressure employed for cutting the comparatively thin sections within its capacity rarely exceeds 40 pounds.

The general rules for setting up, lighting the torch, and shutting down apply to the combination outfit in all respects. Avoid the use of oil or grease on the connections, and be sure that all connections are screwed up tightly before lighting.

The cutting tips fit a tapered seat in the torch head, and care should be taken that the tip is clean before putting it in place. Screw the tip nut firmly; if for any reason the torch head should become overheated, do not tighten the tip nut until the torch head has been allowed to cool, and remove the tip nut if cooled in water. Use the smallest tip consistent with the thickness to be cut. The No. 1 tip will cut all thicknesses of steel from 1/8 to 1/2 inch. If necessary to cut sections up to 3 or 4 inches, use a No. 4 tip.

The operation of cutting with the combination outfit is one of heating the metal to bright red with the preheating flames, and then pressing the thumb lever to turn on the oxygen jet that does the cutting. The torch is held at the angle desired for the cut and moved along slowly, keeping in step with the cutting action. All oxide and scale adhering to the cut surfaces should be cleaned off before starting to weld.

The directions for setting up apparatus, lighting the torch, and adjusting the pressures are supplemented with the following specific points not fully covered in the foregoing:

Flashbacks in general are caused by a mixture of oxygen and acetylene in either hose. This mixture may be formed in any one of a number of ways, a few of which are enumerated herewith:

1. Lighting the torch with a sub-normal pressure in one hose and a normal or excessive pressure in the other hose.
2. With proper pressures in both hose line but with a stoppage in the tip beyond the point of mixing.
3. Leak between the oxygen and the acetylene in the

torch head seat due to foreign substance, bruised or warped contact surfaces, or insufficient pressure on the wrench when screwed up.

4. Temporary obstructions of gas flow in either hose caused by kinking of the hose or by external pressure applied on the hose by some heavy object dropped or lying on it.

5. High acetylene pressure due to improper adjustment of regulator followed by stoppage or obstruction beyond the point of mixing of the gases.

6. Bleeding either oxygen or acetylene cylinders by forcing the regulator seat away from the nozzle and allowing a mixture to form in the cylinder. This, in case of a flashback, is likely to be serious.

7. Long lengths of hose may be indirectly responsible for flashbacks because of the practical impossibility of keeping long lengths free from kinks that may reduce the flow of gas or stop it entirely in one line.

To avoid backfires and flashbacks two conditions of lighting and adjusting the torch should be considered: (A) Starting up a torch on new cylinders; (B) Relighting the torch after having been in use.

A. Starting Up on New Cylinders

1. Clean the oxygen outlet on oxygen cylinder and regulator connections of all dirt, oil, or other readily oxidizable material.

2. Open oxygen valve slightly to blow out any dirt in the passage. Close quickly.

3. Attach the oxygen regulator firmly to the oxygen cylinder valve and fully release the regulator screw by turning out (counter-clockwise) if this has not been previously done. The adjusting screw on regulators should always be in released position when not in use.

4. Open oxygen valve on cylinder slowly, standing at one side of the regulator. Oxygen cylinder valves should be opened as far as they will turn.

5. See that the acetylene outlet on the acetylene cylinder and regulator connections are clean.

6. Open acetylene valve slightly to blow out dirt that may be in the passage, being careful that no flame is near the escaping acetylene. Close quickly.

NOTE.—If working in a confined space, this operation must be omitted.

7. Connect the acetylene regulator to the acetylene cylinder valve, and slowly open acetylene cylinder valve one full turn.

8. Connect the oxygen hose to the oxygen regulator and the acetylene hose to the acetylene regulator, and make the proper hose connections with the torch.

9. Having connected the torch to the regulators with the hose lengths, observe the cylinder pressures and make certain that both cylinder valves are open and that there is excess pressure in each cylinder over that required for the proper operation of the torch. Do not try to operate with cylinders that are practically empty.

10. Adjust the acetylene regulator to the correct operating pressure with the acetylene torch valve open and with the oxygen torch valve closed. Now close the acetylene torch valve. If working in a confined space or in the presence of other flames, light the escaping acetylene when making the adjustments.

11. Adjust the oxygen regulator with the acetylene torch valve closed and the oxygen torch valve open. This done, close the oxygen valve.

12. Open the acetylene torch valve, and light the acetylene as it leaves the tip, using a sparklighter. Then adjust the acetylene flame until the distance between the flame and the end of the tip is approximately ⅛ inch. (A flame closer to the tip denotes insufficient acetylene pressure; a flame more than ⅛ inch away usually denotes too high acetylene pressure, and is likely to be blown out before the proper adjustment can be made.)

13. With the acetylene flame burning, gradually open

the oxygen torch valve until a neutral flame is obtained, after which the acetylene valve may be opened wider. This operation should, of course, be followed by again opening the oxygen valve until a neutral flame is again obtained.

B. Starting Up After Shutting Down

Carefully observe the following after shutting off the torch without having closed the cylinder valves. The regulators have been previously adjusted.

1. With the acetylene torch valve closed, open the oxygen valve and allow the oxygen to blow through for approximately five seconds. Then close the oxygen valve. The purpose of this operation is to blow out any explosive mixture that may have formed in the hose. Longer time may be necessary in the case of hose lines over 25 feet long.

2. With the oxygen torch valve closed but with the pressure on the line, open the acetylene torch valve and allow acetylene to blow through the tip for approximately five seconds. Longer time may be necessary in the case of hose lengths over 25 feet long. The purpose of this operation is to blow out any explosive mixture that may have formed in the hose. The operation should not be carried out in close proximity to a flame.

3. With the acetylene torch valve open, light the acetylene at the tip, using a sparklighter, and then adjust the flame as directed in Nos. 12 and 13 of the preceding instruction.

Closing Down

1. Close the acetylene torch valve.
2. Close the oxygen torch valve.
3. Close the acetylene cylinder valve.
4. Close the oxygen cylinder valve.
5. Drain acetylene hose by opening the acetylene torch valve, having previously closed the oxygen torch valve. Then immediately release the regulator screw on the acetylene

regulator by turning the screw out (counter-clockwise). Then close the acetylene torch valve.

6. Drain oxygen line by opening oxygen valve on the torch (acetylene valve having previously been closed), and immediately release the pressure on the oxygen regulator diaphragm by turning the regulator screw out (counter-clockwise), then close the oxygen valve on the torch.

Cautions

Do not light torch with both torch valves open.

Do not use excessively long lengths of hose.

Do not use any but hose manufactured especially for the gases being used.

Do not use defective apparatus.

Do not use hose that is kinked or has obstructions in the gas passage.

Do not turn regulator adjusting screws in to bleed cylinders.

These directions must be faithfully followed in principle because they embody the basic essentials for safe, efficient operation and sound welding.

• • • • •

The next step is learning to hold the torch and rod while making a weld, that is, the art of manipulation.

By torch manipulation we mean holding the torch at the correct height and angle, directing the flame so as to fuse the base metal evenly, and moving the flame back and forth across the joint along an approximately zigzag path. The combination of correct flame approach to the work and manipulation across the joint may be learned by preliminary practice welding without rod. This practice welding can be done on steel plates about 6 inches long, 1¼ inches wide, and ⅙ inch thick, using a No. 2 tip.

The operator should be dressed for welding, and should wear goggles and gloves. Although it is true that light welding can be done without goggles or gloves, it is, nevertheless, necessary to wear them because it is part of the beginner's job to become accustomed to looking at the weld through colored lenses, and to hold the torch and welding rod with gloved hands.

Practice welding is done on a welding table or stand. In the absence of a regular welding table one can be improvised with a work-bench, kitchen table, or box set so that the top is about 30 inches from the floor. Any wooden top must be protected from fire. Cover it with heavy sheet asbestos or with building brick laid flat and sprinkled over with dry sand to fill between. Provide two firebricks for the welding supports and a pair of steel pliers to handle hot metal.

Set the welding outfit alongside the table, at the right, turn on the gases, and adjust the working pressures for a No. 2 welding tip—2 pounds of oxygen working pressure and 2 pounds acetylene.

1. Lay two of the 6-inch pieces on the firebricks side by side, bridging across so that about 1/4 inch rests on the bricks at each end.

2. Open the acetylene needle valve and light the torch with the sparklighter.

3. Open the oxygen needle valve and adjust for the neutral flame.

4. Pull the goggles down over the eyes.

5. Hold the torch loosely in the right hand, grasping the handle at a point where the hose hanging free nearly balances the over-hanging tip.

NOTE.—Welders holding the torch in the left hand should set the tip and mixer head in the torch so that the needle valves are next to the body, or pointing down, so as to be convenient to open and close with the right hand.

6. Tack the left end of the plates together. This is done by holding the flame close to the joint until the steel melts and runs together. Remove the flame instantly when the metal flows, as otherwise a hole will be burned through.

7. Warm the two plates by passing the flame over them lengthwise two or three times.

8. Start welding at the right. Hold torch loosely in the hand and nearly parallel to the top of the welding table.

Incline the tip sideways so that it points to the left at an angle of about 45 to 50 degrees to the welding plates.

9. Move the flame across the joint back and forth, giving it a movement of about ⅛ to ¼ inch. As the steel melts and flows together move the torch to the left slowly following a zigzag path.

NOTE.—Sheet steel often is welded with very little or no movement of the torch across the joint, **as in body and fender welding.** The torch is alternately raised and lowered instead. But the beginner is advised to use the zigzag method while learning because it must be employed on thick beveled plates when working on frames and brackets. He can adopt the production method for thin metals later when proficient in prepared or beveled joint welding.

10. Keep the torch in motion, but do not move to the left along the joint faster than the advance of the puddle. Be sure that each plate edge receives its due share of the heat.

11. Hold the torch easily. Do not hold the handle tightly. Gripping it firmly tires the muscles, and makes the arm tremble. Learn to work easily and surely. Don't hurry.

12. Continue a uniform zigzag motion keeping the white hot cone just above the surface of the plate. The rate of welding progress is determined by the puddle. You can weld no faster than the advance of the puddle; neither can you weld much slower because if you stop advancing the torch and puddle, the hot metal will drop through.

13. When nearing the end of the joint, lift the torch higher to avoid making a hole in the weld at the end. **This is an important point in welding thin metal.**

14. Pick up the welded plates with the pliers and examine first for uniformity of torch manipulation each side of the joint. This will be indicated by the heat zone. The heat zone should be of uniform width on both sides of the weld. Turn the piece over and examine for penetration, that is, if the weld penetrated to the bottom of the plates.

After having made a number of fairly satisfactory welded specimens, try building up the groove with welding rod to reinforce the weld. Use $\frac{1}{16}$-inch welding rod.

The welding rod is bent, letting 4 or 5 inches stand out at right angles to that held in the beginner's left hand. The job now is to fuse the weld along the groove, and to melt the welding rod into the puddle to fill and build up a slight reinforcement.

The operator should manipulate the torch as before, moving it in a zigzag path and traversing toward the left with the puddle so as to fuse it into the groove in the right amount at the right time.

Manipulation of the rod consists of holding the end over the joint close to the flame and moving it so that it is momentarily immersed in the puddle ahead of the flame. The heat of the puddle and flame melts off a drop of metal which blends into the weld. The beginner as a rule will have difficulty in dipping the rod and lifting it at the right moment. If done too soon it will stick because the puddle is not hot enough to fuse the rod, and if done too late the puddle becomes so hot that it drops through.

If repeated effort is rewarded with little success, special practice on this phase of manipulation may be necessary.

Welding Cast-Iron

Gray cast-iron used for making cylinder castings is welded with cast-iron welding rods or "sticks," using a flux. Cast iron melts at a lower temperature than steel—from 1850 to 2250° F., whereas steel melts at 2200 to 2800° F., depending on the carbon content. High-carbon steel melts at the lower temperatures and low-carbon steel at the higher ranges.

The melting-points of cast-iron are below the fusion temperatures of the iron oxides, and it is necessary to use flux to dissolve them in making cast-iron welds.

Flux is generally applied by sticking the hot welding rod into a can of flux powder. The quantity adhering is sufficient as a rule. When welding heavy castings, however, the weld puddle may be dusted with flux from time to time in order to supply the required quantity.

Practice welding on cast-iron should be done to acquire knowledge of its peculiarities and the necessary torch and rod manipulation. The welding rods as a rule are used straight which is not quite as convenient for manipulation as the bent rod on steel.

Expansion and Contraction

Care must be taken to provide for expansion when welding a gray iron casting and likewise the contraction must be controlled in cooling to prevent cracks in the weld or adjacent to it. These are best taken care of by preheating the casting to a low red heat, using city gas, oil burners, or charcoal. A crude furnace of firebricks may be built around the part, and the top covered with sheet asbestos except where the weld is to be made. The heat is brought up slowly and as uniformly as possible. When the weld is completed and still in the furnace it is covered with asbestos and allowed to cool slowly. Heavy casting may require 24 to 48 hours to cool, depending on the size, shape, and weight.

Welds made with approved cast-iron rods and flux in the manner described should be soft and machinable when cold.

Bronze Welding Cast-Iron

Many cast-iron repair welding jobs can be done to advantage with bronze welding rods. The preheat required is less, and the welding rod temperature is from 1625 to 1650° F. Many jobs can be done with very little or no preheating. Flux is used when making bronze welds. The strength of good bronze welds is equal to or greater than the base cast iron.

Malleable Iron Castings

Malleable iron castings are produced from **white iron** castings heat-treated in specially designed furnaces while packed in boxes with hematite ore. The resulting product is soft and bendable, but it is not weldable with iron or steel rods. It should be bronze welded when making repairs.

The white iron castings can be welded, however, with white iron rods, and defective castings can thus be salvaged in the course of making malleable castings.

Welding Non-Ferrous Metals and Alloys

Welding of copper, aluminum, bronze, brass, monel, nickel, and various alloys is accomplished with the oxyacetylene torch in production and repairs. These metals and alloys as a rule are very easily oxidized and a strictly neutral or slightly carburizing flame is used; also appropriate welding rods and fluxes. Expansion and contraction are greater than with steel, and special fixtures often are used to hold sheets and other shapes. Heat conductivity is higher, and larger tips are required for the same thickness than on steel. Copper, for example, requires tips from one to two sizes larger than for steel of the same gauge.

Welding rods as a rule are of the same metal as the metal welded. Pure copper rods are used on copper, aluminum wire on aluminum sheets, aluminum alloy cast rods on aluminum castings, bronze on bronze, nickel rods on nickel, and so on.

Ordinary commercial copper is difficult to weld but so-called deoxidized copper may be welded with satisfaction.

Learning To Cut

Cutting or burning wrought iron, steel, and cast iron with the oxyacetylene torch, to effect separation, requires a torch designed for cutting and torch manipulation quite different from that for welding. Cutting is essentially simple but like many other simple operations success depends upon learning that which can be acquired only by practice.

A good cutting operator is one who holds a torch steadily and moves it at uniform speed over the piece, the speed being adjusted to the thickness and cutting tip. Gas pressures and tips must be used appropriate to the job.

If the cut wavers from side to side a wider kerf will be made which means more oxygen consumption and slowing down the speed. If the operator is unable to move the torch at uniform speed but goes ahead at an irregular rate, that also slows down the cutting and increases gas consumption.

The operator should dress for cutting, and wear gloves and goggles. Always pull the goggles over the eyes before starting.

Starting To Cut

As a rule a cut is started at the edge of a plate or forging. The preheating flames are held above the steel at the edge until the metal becomes bright red, and then the trigger or lever controlling the oxygen cutting jet is pulled, and cutting starts. The torch should be held with the tip vertical and should be kept in a nearly vertical position when making a square cut, or at an angle of about 45 degrees when beveling for welding.

If necessary to start a cut in the metal away from the edge, heat the metal to a bright red and hold the heat a little longer than when starting on the edge. Now raise the torch about ½ inch and pull the trigger. As soon as the plate is perforated lower the torch to the normal position, and proceed with the cut.

CHAPTER IX

ARC AND SPOT WELDING

While many shops feel that arc welding is sufficient for body and fender work those that have investigated spot welding in service work find it very important in many ways. One of the best examples of equipment for both spot and arc welding is the Allen model E-296 machine which with suitable tongs for spot welding and rods for arc welding handles service welding exactly as the original welding was done in manufacturing the car. Since this Allen machine was among the first to provide this double performance the following instructions have in mind the use of this equipment.

Assembly and Connections

Both the spot and arc welder are assembled complete in the same cabinet, and after the crate is removed, it is only necessary to insert the casters in the base and connect the A.C. cord to a 220-volt line of the same cycle as shown on the name plate.

The A.C. supply current cable at the back of the welder is provided with three separate wires. One of these is red in color, and being the ground wire should be connected to a water pipe or other suitable ground. The gray and the black wires are for connection to a 220-volt single-phase line, or to any two of the three wires of a 220-volt three-phase line, or to the two outside wires of a three-wire 110-220 lighting circuit line.

To Operate as a Spot Welder

Before any use is made of the spot welder, the parts which are to be joined must be **securely clamped in place** (this is important) with C clamps, or a similar means. The sheet metal must be reasonably clean of grease or paint, so that a good contact may be made with the copper spot welder tongs. It is possible to burn through a greasy coating, but this introduces unnecessary burning of the spot welder tongs, and causes them to wear faster. The tongs must be kept reasonably clean for the same reason, that is, to prevent burning and arcing.

Occasionally it will be necessary to file the point of the tongs to keep them clean and pointed. Care must be exercised in placing the tongs in the hand piece to prevent their machined surfaces from becoming burred or otherwise damaged. Their fitting perfectly is important, as good electrical contact is necessary. In case they become damaged, they should be dressed smooth with a fine grade of sandpaper.

Select the necessary jaws to perform the desired operation. Next, place the tongs in the hand piece assembly, and adjust them so that the points are in line and make proper contact when they are closed. Tighten them securely with the thumb nuts.

To Make a Spot Weld

To make a spot weld, place the hand piece in postion so that one tong is on one side and the other is on the other side of the two pieces of metal to be welded. Close the handles firmly together, bringing the tongs into contact with the metals. Next, press the switch button in the handle, holding it down until the metal to be spotted has turned red hot in a small circle, around the points of the tongs. (This usually requires from 5 to 10 seconds.)

The current is flowing in the circuit, and through the metal while the switch button is closed. After releasing the button, open the handpiece and proceed to the next place to be spotted, and repeat the operation.

If the pieces of metal to be spotted are not clamped tightly together, the current may arc between them and cause burning instead of welding. Also, if the current is not allowed to flow long enough, a good weld will not be obtained because the heat will not be sufficient to properly fuse the metals.

It is also possible to apply the heat for too long a period, in which case the metal becomes overheated, and often results in burning a hole or a crater. A good spot will be smooth, except for a slight indentation where the points of the tongs were in contact with the metal.

A little practice on the part of the operator will result in his being able to make perfect welds. If the spot welder tongs become excessively hot, due to a large number of spots being made, they can be dipped in water and cooled without damage to the tongs.

Procedure for Spot Welding: New Steel Tops

Before removing the damaged top, it is important that the body be realigned if necessary, so that the new top will fit perfectly when placed in position. It is much easier to do any realignment that may be necessary before the old top is removed than after it has been cut from the body.

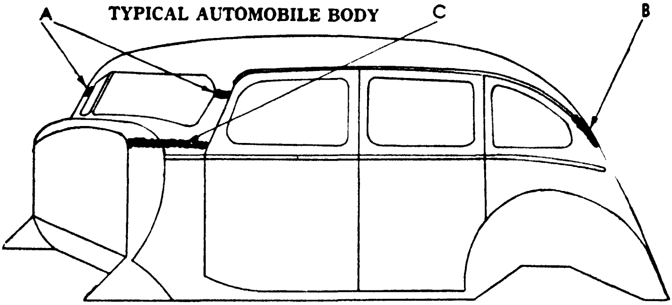


Fig. 63. Location of welds in typical auto bodies. *A* and *B* are arc welding operations on Fisher, Hudson, Chrysler, Graham, Packard, and Studebaker bodies. *C* represents spot welds on Ford bodies and arc welds on all others. All operations on Ford and Willys bodies are spot welds. All operations on Nash bodies are arc welds.

To remove the top, it should be cut just above the original spot welded seam, as indicated in Fig. 63, and while this leaves a double thickness of metal at the seam, it does not in any way interfere with the installation of the new top, as the weld can be made through the three thicknesses of metal.

After the old top has been removed, the flanges of the body should be ground smooth and clean, so that all paint and dirt is removed.

Before fitting and clamping the new top in place, remove the paint with thinner from both surfaces of the top flanges, so as to insure good electrical contact for the spot welder tongs.

If the top is to be installed on a coach, it is necessary to cut a portion of the flanges from the top, that is, all of that portion that extends backward from the rear end of the door opening.

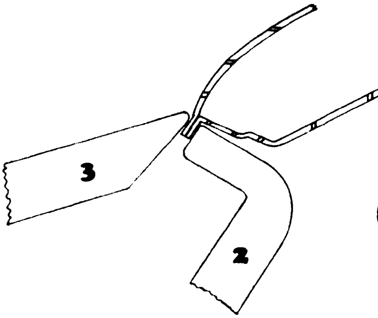


Fig. 64. Spot welding the top to the windshield frame using tongs Nos. 2 and 3. This operation is the same for Ford, Fisher, Studebaker, Hudson, Chrysler, Graham, Willys and Packard.

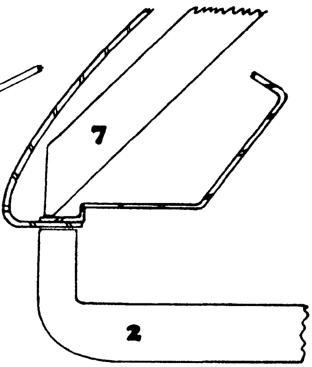


Fig. 65. Spot welding the top to the windshield frame of the Chevrolet. Tongs 7 and 2 are used.

The first operation is to spot weld the top to the windshield frame, using tongs No. 2 and No. 3 as is shown in Fig. 64.

Fig. 65 illustrates spot welding the top to the windshield of the Chevrolet body. Note that the tongs used are No. 2 and No. 7. See Fig. 66 for all tong shapes.

When the windshield is welded, next proceed to spot weld the rear deck frame at the rear window to the top, using No. 3 and No. 4 tongs. The procedure is shown in Fig. 67. If preferred, tongs No. 2 and No. 3 may be used.

Then spot weld the roof rail to the top over the door openings, first on one side of the body, and then the other, using tongs No. 1 and No. 2 as shown in Fig. 68. If extra pre-

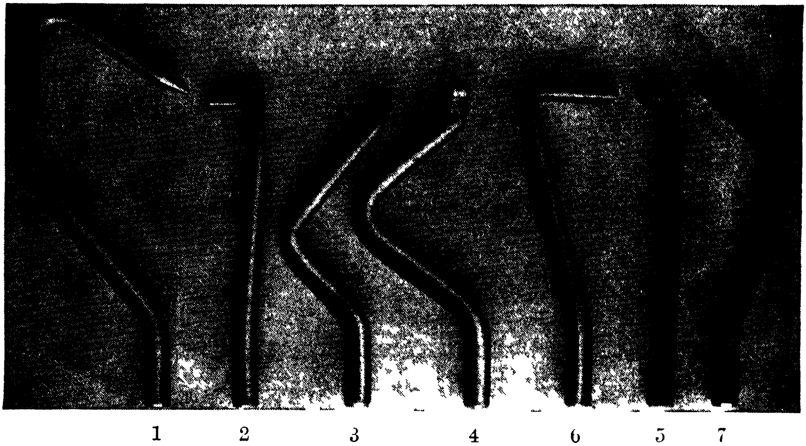


Fig 66 Allen tongs provided for various spot welding jobs

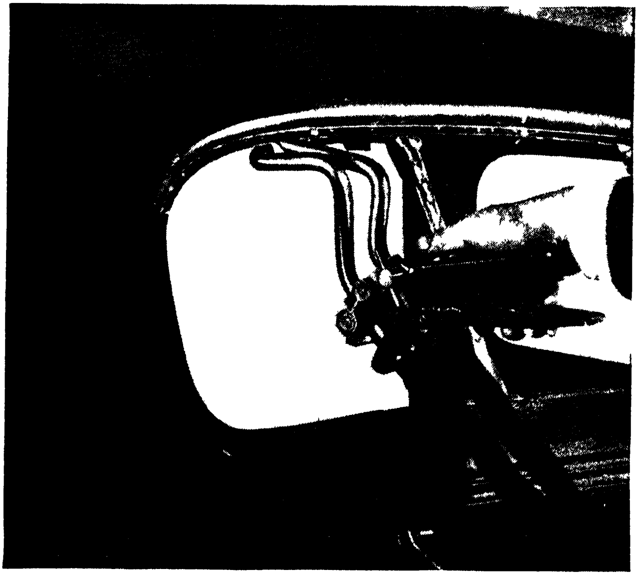


Fig. 67. Spot welding top to rear window frame on Fisher, Chrysler, Hudson, Ford, Packard, and Willys

caution is desired, in order to prevent any possibility of squeaking, then additional spots can be made on the lower portion of the flange, using tongs No. 2 and No. 3, or tongs No. 2 and No. 7, if preferred.

The next step is to spot weld the flanges of the top to the rear quarter panels, inside and over the window openings on both sides of the body, using tongs No. 3 and No. 4.

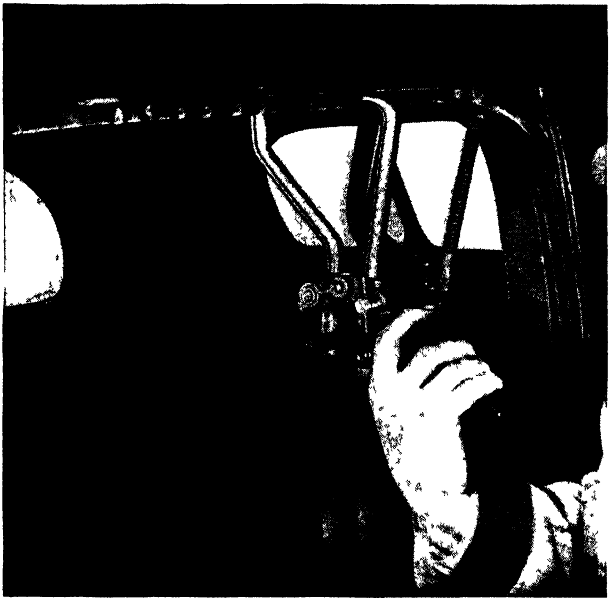


Fig. 68. Spot welding the top to the roof rail over the door opening of Packard, Fisher, Graham, Hudson, Ford, and Chrysler.

The foregoing completes the spot welding operation, and it is then necessary to arc weld the seams, joining the top to the body, as indicated in Fig. 69.

The reason for adhering to the procedure outlined in the foregoing is that if the body does not line up perfectly with the new top, this misalignment is easily overcome, while if some other sequence than the foregoing is followed, buckles will invariably occur in the top.

Replacement of Metal Tops

The body construction of older Studebaker cars differs from that of most other makes along the seams where the top is joined to the rear quarter panel and where the roof rail is attached to the top over the door openings. A four-sided frame is used, and the spot welding has to be done by inserting the tongs through openings in the four-sided frame. It is because of this that the specially constructed tongs No. 5 and No. 6 are required (Fig. 66).

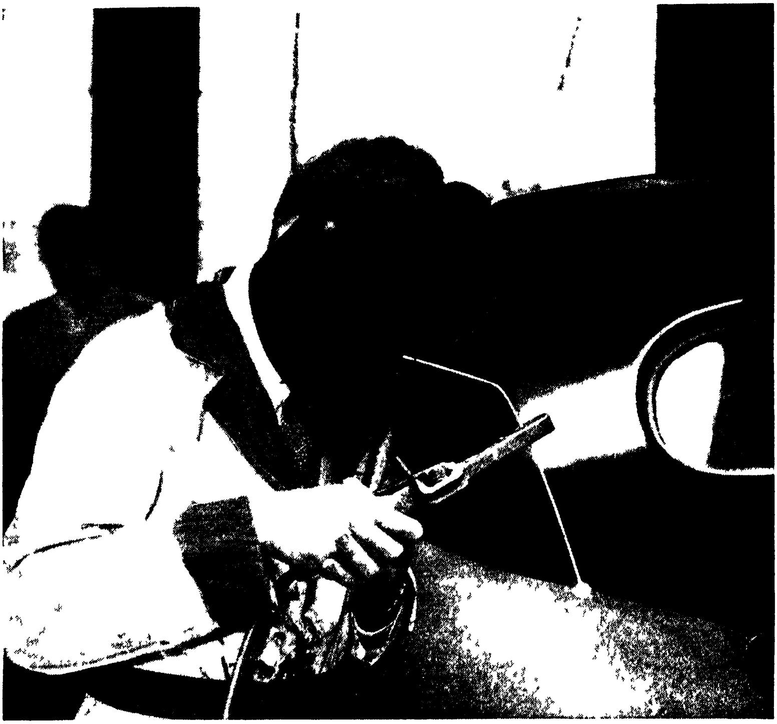


Fig. 69. Arc welding the seams joining top to body.

The windshield frame is attached to the top the same as on other cars using tongs No. 2 and No. 3 as shown in Fig. 64.

Fig. 70 illustrates the method used for spot welding the rear window frame to the top using the same tongs.

Figs. 71 and 72 illustrate the box frame construction, and show the tongs to use in spot welding the top to the roof rail over the door openings (tongs Nos. 2 and 6) and also the rear quarter panel to the top (tongs Nos. 3 and 5). The operation is the same on Willys bodies.

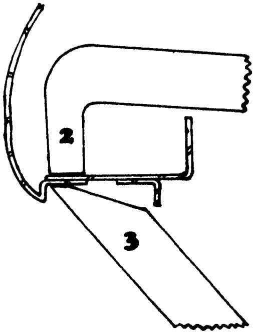


Fig. 70. Spot welding top to rear window of 1937 Studebaker.

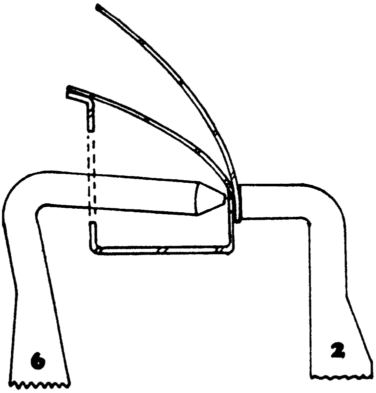


Fig. 71. Spot welding top to roof rail over Studebaker door opening of the car. Operation is the same on Willys.

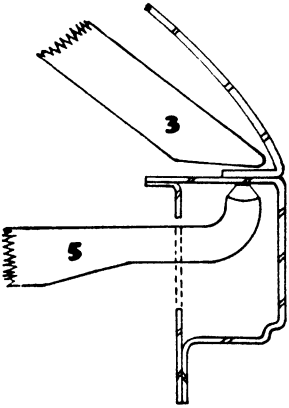


Fig. 72. Spot welding rear quarter panel to top of Studebaker.

To Operate As an Arc Welder

The stencil on the front of the welder contains complete information as to the size rod to use for all thicknesses of metal, and what plug to use for each heat range.

The permanently attached cable (under stencil on front of welder) is the ground lead, and **must be securely grounded** to the metal to be welded.

Then, to obtain from 15 to 25 amperes, plug the detachable cable into No. 1 socket (under stencil) and rotate the control switch. There are six positions on the switch, which provide six heats for each plug-in socket.

With the cable in socket No. 2, the heat obtained ranges from 30 to 45 amperes in progessive steps between these heats, as the control is rotated.

NOTE.—WHEN USING 15 TO 25 AMPERES, IT IS SOMETIMES DIFFICULT TO START THE ARC IF THE METAL IS COLD, IN WHICH CASE IT SHOULD BE STARTED AT A HIGHER RATE. THEN WHEN THE METAL AND ROD ARE HEATED, DISCONTINUE THE ARC AND TURN THE CONTROL TO THE LOWER HEAT RANGE DESIRED, AND PROCEED IN THE USUAL MANNER.

Learning How To Arc Weld

Before beginning to weld, the metal should be free of oil, rust, scale, etc. Scale and rust can be removed with a scratch brush.

The First Step.—The first step is in learning to strike and maintain the arc, which is done in a manner similar to striking a match. The tip of the rod is brought into contact with the metal by a short sweeping motion, which, as soon as the arc is struck, carries the rod away from the metal about 1/16 of an inch.

Before any attempt to weld is made, the operator should practice striking and holding the arc until it becomes largely an automatic procedure.

If difficulty is experienced in striking the arc with the heat selected, it may be necessary to raise the heat as explained in the above Note, and weld for a distance of approximately 1/4 of an inch. Then the heat can be lowered so that it does not burn holes in the metal.

It will be noted that the heat is **less** when the rod is close to the metal, and **greater** when the heat is farther away, which is just the opposite in acetylene welding.

The Second Step.—The second step is to maintain the arc by keeping a constant gap between the metal to be welded, and the welding rod. This is accomplished by moving the hand slowly in a downward motion at the same speed that the rod burns away, and at the same time the rod should be moved slowly with a uniform motion along the direction the weld is being made. The rate of travel will be governed by the rate of deposit of the welding rod on the metal being welded, and it is advisable to practice depositing the welding rod in a straight line on a single piece of metal. No attempt should be made to join two pieces of metal until the above has been mastered.

The Third Step.—The third step is to attempt to butt weld by placing two pieces of metal together, end to end. The rod should then be moved in a zigzag manner along the seam to be welded. This produces a path for the welding rod, much as are the teeth on a saw. The purpose of this is to secure sufficient penetration of the rod material to the metals on either side of the weld to obtain maximum strength, and to prevent burning of the metal.

The Fourth Step.—The fourth step after becoming proficient in the foregoing is to place two pieces of metal in a vertical position, and, with the amperage of the machine reduced, proceed exactly as is explained in the preceding paragraph, always starting from the top of the seam in order to secure the smoothest weld.

The Fifth Step.—The fifth step is to place two pieces of metal in a horizontal position, and weld them from the underneath side.

Having mastered all of these steps the operator is now ready to weld sheet metal. To do this, secure an automobile fender, or similar material, and with the welder set on one of the lower heat stages, proceed in the same manner as explained in the foregoing. Care must be exercised in holding a constant and very close arc, as otherwise the metal being welded will burn through. Also, greater care must be used to strike the arc than when welding thicker metals; as with the small amperage, this operation is more difficult.

As in the case of learning to weld heavy metal, no attempt should be made to weld a seam or tear on the sheet metal until the operator has mastered the ability to weld a neat bead in a straight line.

In the event that burning is experienced on an exceptionally thin and rusty piece of sheet metal, a fourth motion of the hand and welding rod is necessary, namely, a rapid up and down motion, much the same as is obtained with an air hammer.

Always remember to hold a very close arc, after it has been well established, as the closer the arc, the less the heat.

Sheet Metal Welding

The technique of sheet metal welding is covered under "Learning How To Weld." In addition to that information, the following should be observed: When welding car bodies, metal tops, or quarter panels, etc., it is advisable to first tack-weld the seam to be welded at spaces of about 4 or 6 inches. Also, all or most of the solder on the old metal parts should be burned or scraped off before starting to weld. However, it is not necessary to remove all solder, as must be done for acetylene welding, as good fusion can be made with the electric process even though a small amount of solder is present.

Welding Sheet Metal to Heavy Stock

This heading covers such subjects as: "Welding Quarter Panels to Wheel Housing"; "Welding Rear or Quarter Panels to Rear Deck Frames"; "Welding Inner Door Panels to Outer Door Panels"; "Welding Metal Tops to Windshield Frames."

When any of the foregoing welds are to be made, or similar cases arise, a $\frac{3}{32}$-inch rod is used with a heat somewhat stronger than should be used on sheet metal only. In fact, the heat can be considerably greater if the tip of the welding rod is held directly over the heavy material, and the weld laid along the edge of the sheet metal. This eliminates burning the sheet metal, and a strong, neat weld will be the result.

When the machine is not in use, always place the dial switch at the "Off" position, as the transformer is then electrically disconnected from the 220-volt line.

Spring Steel Welding

A very satisfactory butt weld of good strength may be made, as in the case of a bumper, by welding both sides of the break, but if exceptionally great strength is desired, it is advisable, after the butt weld is completed, to weld a short piece of spring steel over one side of the bar, and to weld the edges only. **Never, in any case,** weld the ends of the piece applied, as to do so will defeat the purpose of putting on the extra bar, because the temper in the large pieces will have been destroyed.

NOTE.—In the case of fairly thin pieces of the foregoing material, they may be butted tight to each other before welding, but when heavy material is encountered, the edges should be beveled or placed not closer than 1/8 of an inch apart.

Cast-Iron Welding

Because of the characteristic of cast-iron to crack after welding due to expansion under heat that has been built up and the consequent contraction when cooling, it is necessary to weld not more than 1/2 inch at a time.

Proper preparation of the joint is essential. The joint should either be ground or beveled out with a chisel. The wider the bevel, the greater the fusion. If the item to be welded is preheated, longer welds can be made. (To heat an engine block, drain water and run engine until block is hot.)

The welding technique is the same as for steel, but in addition to being limited to 1/2 inch at a time, it is also advisable if an exceptionally long crack is to be welded to make a ¼-inch tack weld, spaced about 2 or 3 inches apart.

It is good practice to lightly peen the bead during cooling, as this will tend to relieve locked up stresses.

IMPORTANT: Always use Allen cast-iron rod and the least heat possible to do the job, so as not to affect the quality of the casting being welded.

Malleable Iron Welding

The same technique is used in malleable iron welding as in cast-iron, either of which metals can be welded separately, or joined together, or either can be welded to steel. Use Allen cast-iron rod.

Welding Cast Aluminum

Cast aluminum is very satisfactorily welded, as in the case of aluminum cylinder heads, by putting into the electrode holder a short piece of ⅜-inch welding carbon and using a medium heat. The carbon is used to maintain the arc, and a ⅛-inch or 5/32-inch coated aluminum welding rod is fed by the operator's other hand.

NOTE.—It is important to remove all scale from an aluminum weld before going over it a second time, or starting again after breaking the arc.

Brazing

Brazing is done with a carbon in the electrode holder, the same as with aluminum, and a coated brass rod is fed into the arc. To use the carbon electrode, sharpen it to a tapered point, approximately 1/16-inch in diameter at the tip, tapering back a distance of at least ¾-inch.

Grip the electrode back 2½-inches to 3-inches from the tapered point.

Fillet Welding

When it is desired to build up an angle formed by two pieces of metal to be welded, it is best to build several layers of welding, one on top of the previous one, until the desired depth is secured.

Cutting Metals

The cutting of metals is best accomplished with a medium or large-sized steel welding rod, using a medium or high heat. The method used consists of moving the rod back and forth over the part to be cut, and with this movement slowly progressing ahead. In the case of vertical cutting, always start at the bottom to allow the molten metal to fall away instead of piling up on the metal being cut.

Eyeburn

Do not look at a welding arc without the protection of a helmet or hand shield. In case of eyeburn, there will be no permanent injury, although the pain may be considerable for several hours.

Allen Welding Rod

Always use A.C. welding rod. D.C. rod is very different in action, and causes difficulty in striking and maintaining an arc, and the deposits are in small beads or drops, which cause a rough finish weld. Furthermore, the dropping action of D.C. rod produces minute temporary shorts in the welding circuit, and, in the case of a long continuous operation, raises the transformer temperature above normal.

Good A.C. rod enables the operator to strike and maintain an arc easily, and give a strong non-brittle weld. An important feature of Allen's rod is that the welded joint has a minimum tensile strength of 50,000 pounds to the square inch, and the welds, even in the case of cast iron, are tough and ductile, which may be machined, ground, or filed, with the same ease as the parent metal. This is because the coating on the rod shields the arc from the surrounding atmosphere, preventing oxidation, and finally deposits itself over the finish weld, allowing it to cool slowly.

CHAPTER X

SHRINKING SHEET METAL

When a surface has been damaged so that the metal has been stretched, it is necessary that it be shrunk.

The Fairmount method, the story of which is told in the photographs on the following pages, has been recognized as a rapid and simple treatment. Get an old door panel and hammer a stretch in it and follow instructions given here. You will find it interesting.

This procedure is shown basically in Fig. 73.

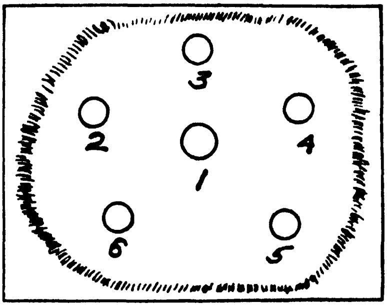


Fig. 73. Sequence of heats in metal shrinking.

A center heat (No. 1, Fig. 73), hammered down as later explained, and then successive rim heats, similarly hammered down, constitute the complete shrinking operation.

It is best to proceed by first roughing out the entire dented area, including the stretch. This operation will indicate the exact size and nature of the bulge or stretch to be shrunk, as shown in Fig. 74. The lacquer should then be removed from the stretched area or bulge with a torch and wire brush.

Three different sizes of heat spots will be found sufficient to cover practically any type of shrinking. On compound curved surface work, a spot not more than 1/8 inch should be heated at one time, while on plane surfaces, 1/4 to 5/8 inch heat spots can be used depending on the amount of stretch and space between the spots; but heat spots in excess of ⅝ inch at one time should never be used.

It is well to remember that body metal loses its temper or spring effect when heated to a cherry red. By heating small spots, the natural spring resiliency is retained in all the metal between the spots.

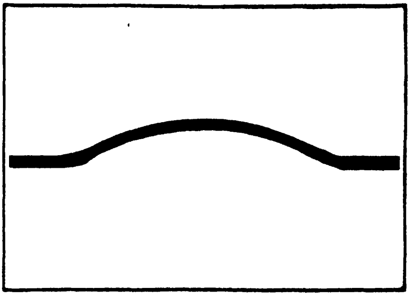


Fig. 74. Diagram representing stretched area to be shrunk.

Most natural surfaces of a body or fender have at least a slight curve; therefore, if the metal is shrunk too much it will cause a flat place at that point and sometimes cause buckles to appear elsewhere in the panel. The flat place would then have to be stretched to the proper level with hammer and dolly, adding labor cost to the job.

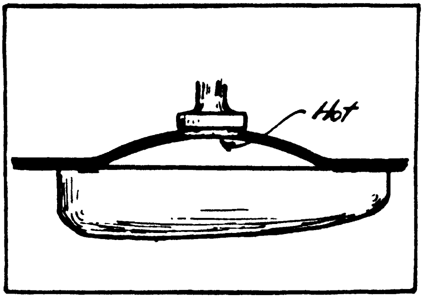


Fig. 75. The start. Here a center heat is being hammered down to the level of the finished panel. Note the crater-like surface thus formed.

The first heat should be applied in the approximate center of the bulge heating a spot to a cherry red, about ¼ to 5/16 inch in diameter, depending upon the size and height of the bulge. This spot is then hammered down while red hot, directing the blows against the red spot, using the flat face of the dolly underneath the ding hammer (Fig. 75).

After this initial heating and hammering operation, the bulge assumes a crater-like shape, as shown in Fig. 75.

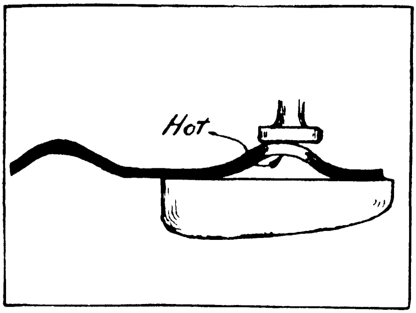


Fig. 76. Diagram showing how rim of the crater is worked down to the level of the panel.

Fig. 77. Photo of first spot used to bring down the rim of the crater.

The next step is to shrink the rim of this crater in successive stages as numbered in Fig. 73. Selecting the highest point of this rim, the heating operation is then repeated, and hammer and dolly used as on the first spot. This is illustrated in Figs. 76 and 77.

On the next high spot which is No. 3 in Fig. 73, the preceding operations are again repeated. It will be observed by this time that the bulged surface is being brought down perfectly and begins to assume its normal shape. Continue this procedure, taking successive numbered spots until the entire bulged area is brought down to the level of the first spots and resembles the surface shown in Fig. 78.

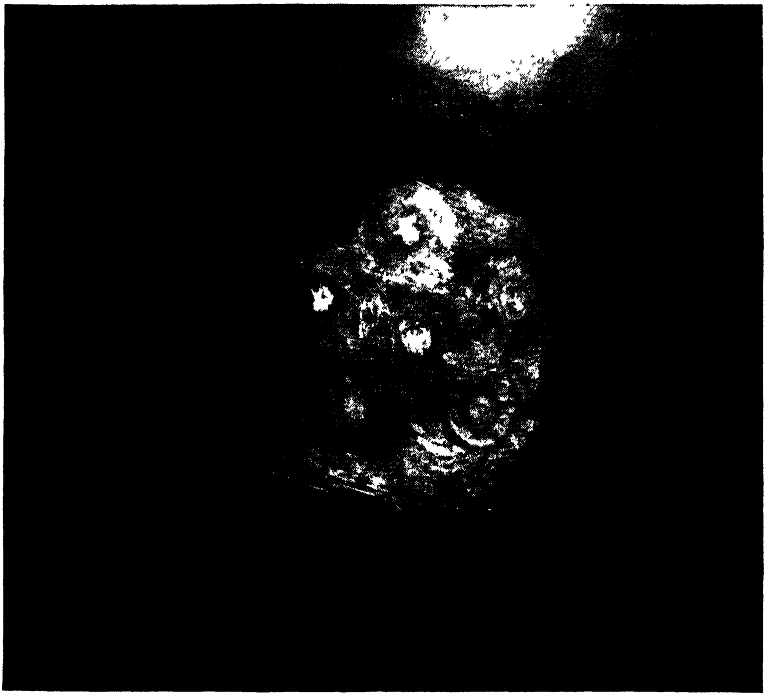


Fig. 78. Panel leveled by repeated heating and dinging.

Due to the expansion of the metal while hot, the surface will be slightly bulged after the last spot is hammered down, and will continue to shrink until the metal is thoroughly cool. Therefore, it is very important to allow the metal to cool before the final dinging is done after which it can be determined whether the surface is at its proper level. Should there be one or more high spots remaining these should be shrunk again, using very small heat spots. After allowing it to cool again the dinging operation is repeated.

The panel surface is then ready for filing or sanding with an electric polishing disk of No. 60 or 80 grit, producing a finished surface as shown in Fig. 79, ready for priming and lacquering.

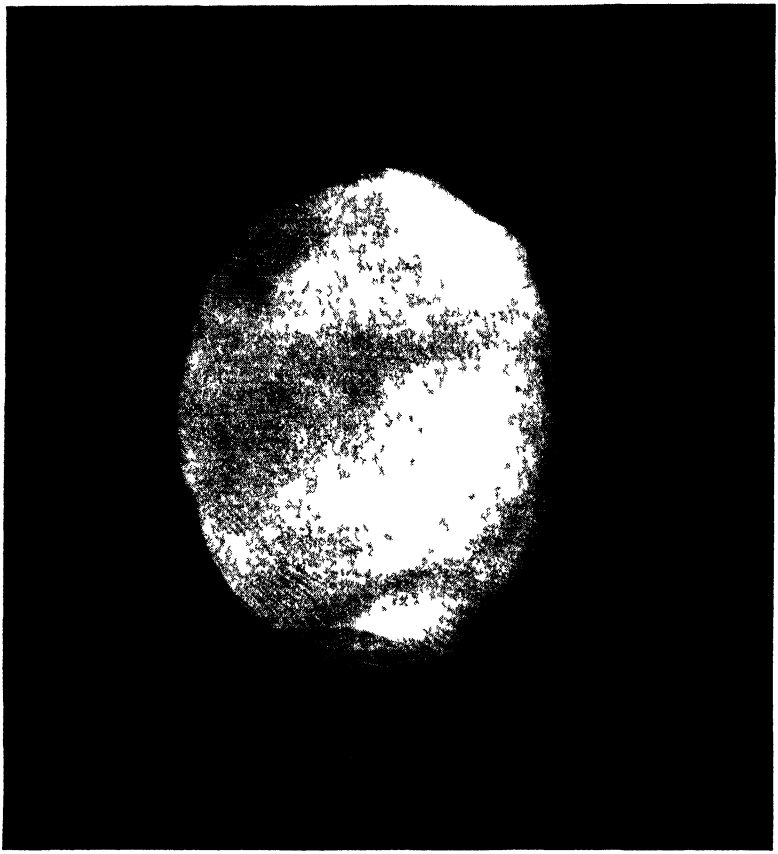


Fig 79 The finished surface after shrinking and before painting

It is suggested here that the inside of the shrunk panel (Fig. 80), be cleaned and painted to prevent rust or corrosion.

If a bulge is unusually high, it will be necessary to shrink the entire bulge down about halfway first, following the foregoing procedure; then, after it cools, reduce the balance by heating the same heat spots used the first time.

Remember that the heat is always applied on the high point and the dolly always held directly under the heat spot which is hammered down while cherry red.

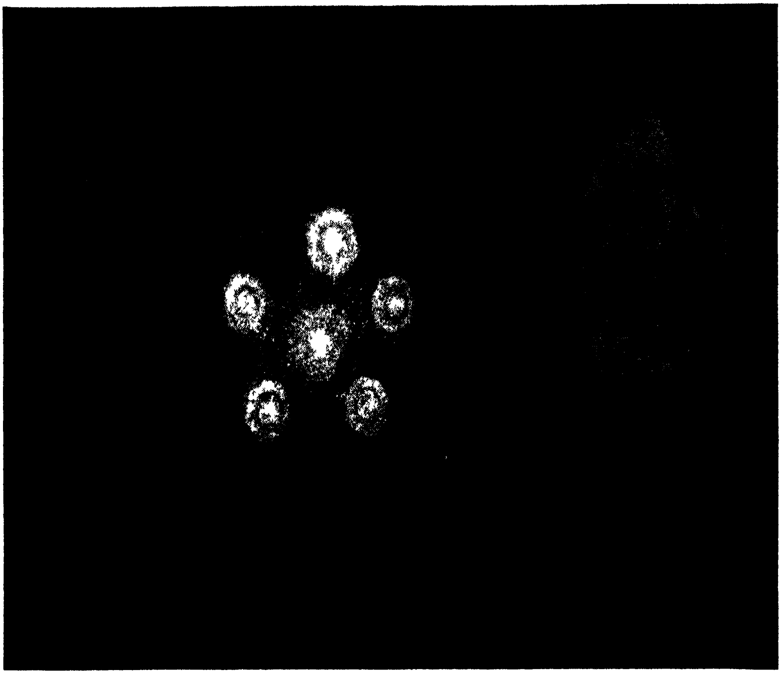


Fig. 80. To prevent rust, the inside of the panel should be painted.

In case of a long narrow stretch caused by a rather sharp object rubbing across the surface, the shrinking is started at either end instead of the center.

The examples illustrated herein were on a bulged area about 6 inches across. Larger areas may require a greater number of heat spots but at further distances apart, depending on height of the bulge.

Aluminum shrinking follows the same general procedure as steel except that care must be used to avoid burning through the metal at point of contact with the flame because this metal absorbs heat much more rapidly than steel and does not change color under heat. It also cools off more rapidly.

Just as soon as the metal starts to blister where the flame contacts the metal, flame must be removed and hammering done quickly with a wood or fiber mallet.

CHAPTER XI

FENDER REPAIRING

Fender bumping and repairing is not as difficult a job as the damaged metal might indicate. A good job is largely a matter of studying the bump or jam and selecting the proper tools to work the bump out. The operator must always keep in mind the fact that the jammed section must be taken out the same way it went in. The reason for this is that when a fender is damaged, a backward strain—or strain contrary to that set up in the metal when the fender was formed—is set up. This strain must be relieved before the metal can be made to assume its original shape.

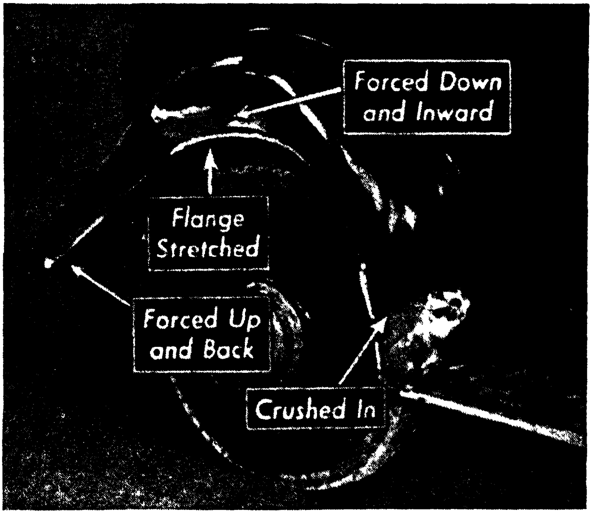


Fig. 81. Damaged fender to be repaired.

To clearly illustrate this job we take a fender that has actually been damaged and follow the steps in its repair, one by one. The fender seen in Fig. 81 is a rear fender that was jammed by being struck in the front and, in passing, the car that did the damage pulled out the rear of the fender. The crown is jammed in and the blow on the rear of the fender caused the outside flange to stretch. For convenience these damaged sections are numbered No. 1 and No. 2, in Fig. 83, beginning with the front of the rear fender.

First clean the fender thoroughly with an oil-soaked rag. The purpose of the oil is twofold: first, to reflect the light onto the damaged section, so that every bump and indentation may be readily seen; second, the oil creates a cushion under the hammer and keeps the paint from being picked up by the hammer.

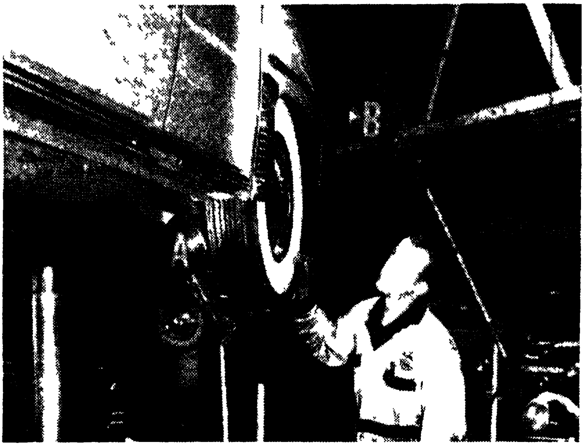


Fig. 82. A pair of shop lamps *A* and *B* arranged to throw light on both sides of a damaged fender.

Then clean the underside of the fender of all grit, tar, and clinging dirt particles. If this is not done, these particles will be beaten into the metal when the hammer and dolly block are used.

Fig. 82 is not the fender being described, but is used to show how two shop lamps give time-saving illumination. These lamps are on portable stands which can be rolled anywhere in the shop.

Rough out jam No. 1, using the proper dolly block, as shown in Fig. 83. Follow the crown of the fender when roughing out this jam. **Never** use a ball peen hammer to rough out a jammed fender or the metal will be full of small "bubbles" and a smooth job will be an impossibility. Selection of the proper dolly block will greatly simplify this operation, because the right block has the same contour as the fender had before it was jammed.

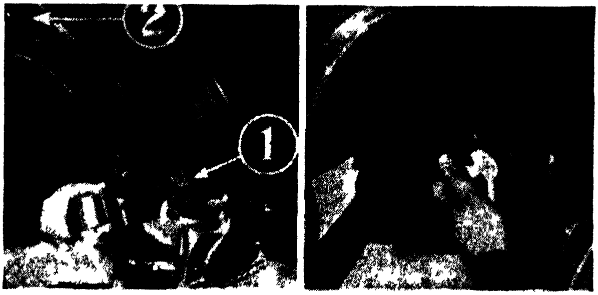


Fig. 83. Roughing out the damaged sections.

Rough out the No. 2 jam to its natural position. Bring the crown back to its original position to form circular pressure in order to complete hot shrinkage.

Fig. 84. Roughing out short, tight jams.

The jam at the rear of the fender shows that the rear skirt has been pulled out and also that the rear corner section is pulled out, making a series of short tight jams. The best method of roughing out short, tight jams is to use two dolly blocks, one held on the bead of the fender to relieve vibrations and the other to rough out the bump (Fig. 84).

After roughing out these tight jams, bring the skirt back into alignment by holding a dolly block behind the low spot and the skirt and hammering the skirt back.

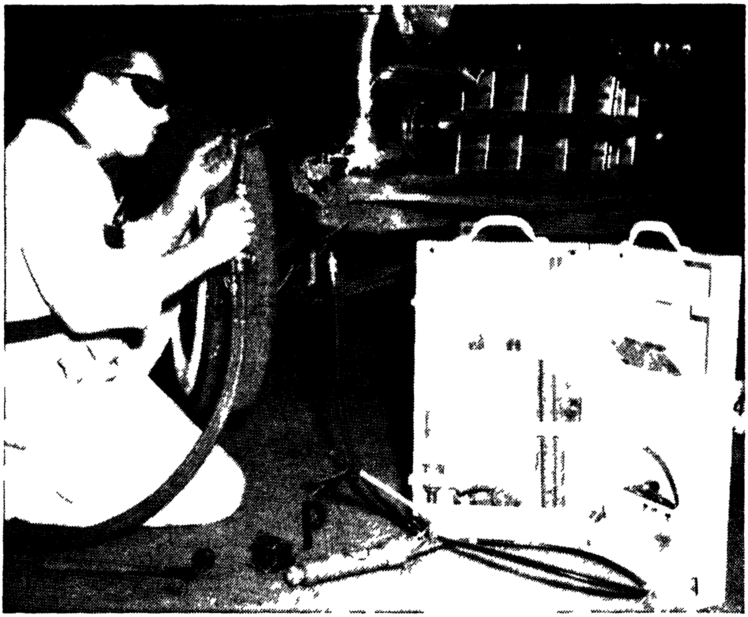


Fig. 85. Mechanic's own Porto Power with jack *J* supporting fender while bead is welded. Note convenient pump *P* By moving handle indicated by arrow, position of edge of fender can be altered.

While Fig. 85 illustrates the most modern time-saving equipment for fender work it is not illustrating the fender under discussion.

Hot metal shrinkage at jam 2 (Fig. 83) will draw the skirt of the fender in and make it rigid. The personalized Porto-Power of Fig. 85 proves handy in controlling such jobs. Then, in the center of the stretched part of the crown, at the highest point of the bulge and about 2 inches up from the bead apply hot shrinkage as explained in chapter X.

Caution: The pressure must be applied to the rear of the fender throughout the entire hot shrinkage process.

If there are any breaks or cracks in the fender they must be welded before the hot shrinkage operation.

Bump out the shrunk section, using a dolly block and a bumping hammer or mallet. Hold the dolly block loosely on the low spots underneath the fender and strike the high spots on the outside with the hammer or mallet. This method causes the dolly to spring back against the low spots and readily smooth them out.

If the fender does not set square or is not shrunk enough, apply more pressure and repeat the process. Always heat on the highest part of the bulge.

To bring the bead into perfect alignment, hold a dolly block behind the low spots and strike the high spots on the bead with a mallet or bumping hammer.

To show up the high and low spots on the rough bumped sections, use a long piece of chalk and holding it flat on the metal, rub the chalk on these sections. The high spots will show up as being white with chalk while the low spots will be dark or unchalked. **Do not file yet.**

Finish bumping the sections by holding the dolly block loosely on the low spots and striking the high spots with a bumping hammer. Check the smoothness of the metal by rechalking; if a smooth job has been done the metal will show up as thoroughly chalked.

The metal may now be finished and prepared for painting with a file and disk sander. At the time the file is being used, any small indentations will show up and may be easily tapped out.

Front Fender Bead Cracked

Most front fender damage is caused by a front end collision, or a blow directly on the front of the fender. It is not enough to simply repair the damage done to the fender, as the fender bracket was pushed back out of alignment at the same time the fender was damaged. With this condition, all of the strain and weight of the fender is thrown onto the outside flange, or bead, causing the metal to crack as in Fig. 86.

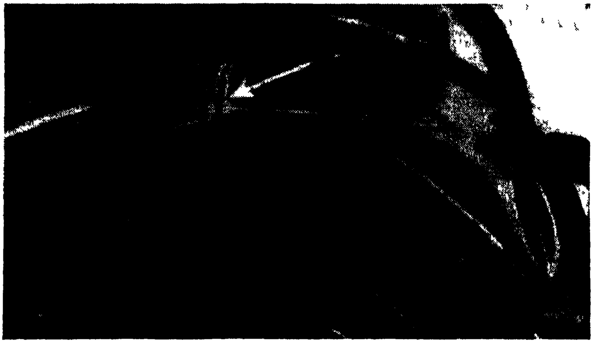


Fig. 86. Fender cracked at the bead.

To relieve this strain, remove the bumper and place a 2 × 4 on the tire and under the end of the fender and pull up on the end of the 2 × 4 until the bead of the fender buckles into its normal position. Then block the 2 × 4 in this position as shown in Fig. 87. Protect the fender paint with wet asbestos. Heat to a cherry red a spot about 2 inches long on the back flange of the fender bracket at a point approximately 14 inches from the outside edge of the fender.

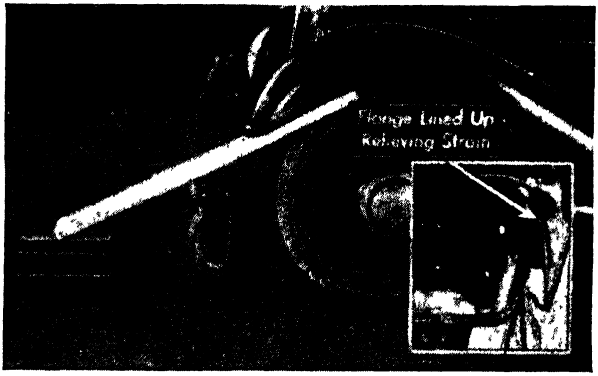


Fig. 87. Aligning fender with board for lever.

Also heat a spot about ¾ inch long on the forward flange of the bracket. This operation is shown very clearly in Fig. 88.

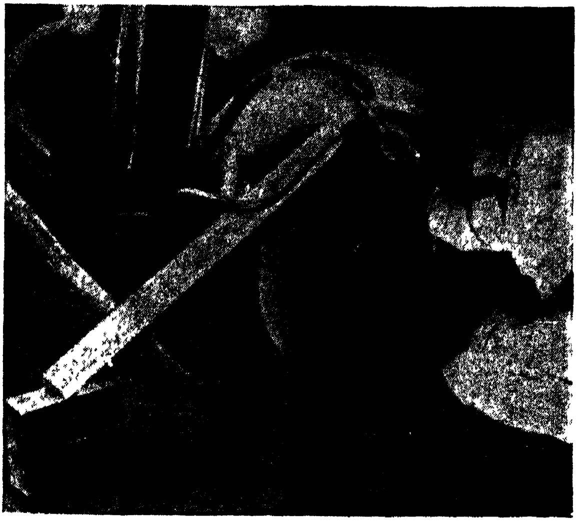


Fig. 88. Normalizing bracket with aid of oxyacetylene torch.

With the pressure still applied, allow the bracket to cool. This will normalize the bracket, causing the strain to be relieved and preventing the fender from cracking at the bead.

When it becomes necessary to repair cracks that have been caused by failure to relieve the strain in the bracket, it is necessary to weld the break before the bracket is normalized.

CHAPTER XII

PANEL REPLACEMENT

Where sheet metal damage is serious, the best repair is generally accomplished by replacing an entire panel. This method saves money for the motorist and makes money for the shop. It also speeds up jobs so that more work can be handled. On special order, practically any part of a modern car body can be purchased. The purchase is generally made through the car dealer, who orders the part from the factory. This may take quite a bit of time.

Some wholesalers carry replacement panels for the more popular cars.

In a few shops it has been the practice to attempt to salvage certain panels from wrecked cars. Doing this, however, is uneconomical since the double labor involved in taking the panel off the old car and putting it on a service job makes costs excessive.

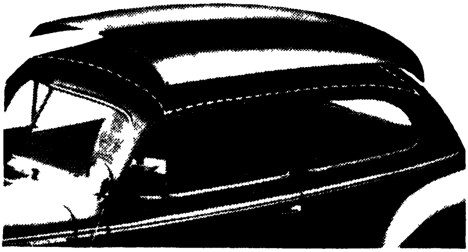


Fig. 89. Modern roof repair panel, with dotted lines showing area covered.

The Chrysler Corporation in cooperation with Chrysler dealers has a panel replacement service for Plymouth, Dodge, DeSoto, and Chrysler cars that is proving popular both with their dealers and with independent repairmen. Other car companies have similar set-ups.

The replacement procedures illustrated here, while generally applicable to all panel replacements, show Chrysler's recommended practice.

Work is speeded and profit increased where the more modern tools and equipment are available.

Cutting out the old panel can be done rapidly either with a power cutter or with a hook-type sheet-metal cutter and hammer. Welding, soldering, and refinishing facilities are, of course, required.

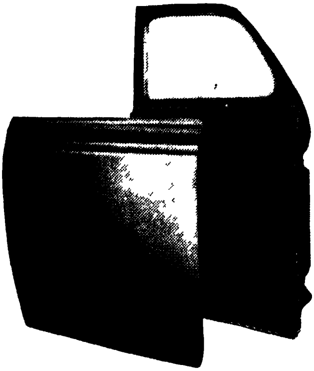


Fig. 90. Door repair panel that assures more economical and more profitable repairs.

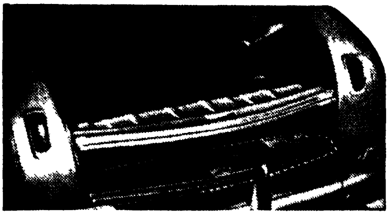
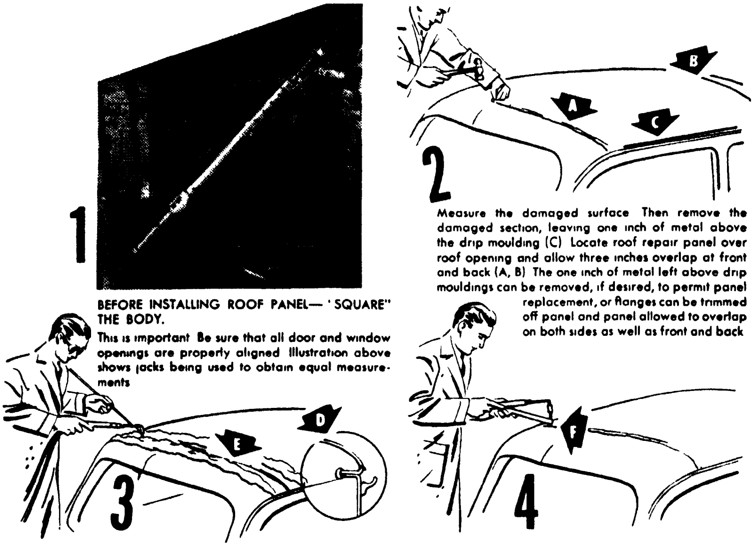


Fig. 91. Dotted lines showing area serviced in luggage compartment with a repair panel.

Roof replacement is handled to best advantage by cutting out the old damaged areas approximately as indicated by the dotted lines in Fig. 89.



BEFORE INSTALLING ROOF PANEL— "SQUARE" THE BODY.

This is important Be sure that all door and window openings are properly aligned Illustration above shows jacks being used to obtain equal measurements

Measure the damaged surface Then remove the damaged section, leaving one inch of metal above the drip moulding (C) Locate roof repair panel over roof opening and allow three inches overlap at front and back (A, B) The one inch of metal left above drip mouldings can be removed, if desired, to permit panel replacement, or flanges can be trimmed off panel and panel allowed to overlap on both sides as well as front and back

Tack weld all four corners (D) and center of each edge. Gas weld or arc weld every two inches (E) with ¼" welds Use enough wet asbestos to protect paint and eliminate buckling from heat

The roof panel overlap should be dinged down after welding Clean thoroughly, blend joint with roof contour and tin Then apply solder, (F) metal finish—and the job is ready for the application of paint

Fig. 92. The four steps in the installation of a roof repair panel.

Doors that have been injured in collision or have had their lower edges rusted out or damaged by rubbing on curbs can be made like new by replacing the panel, as shown in Fig. 90.

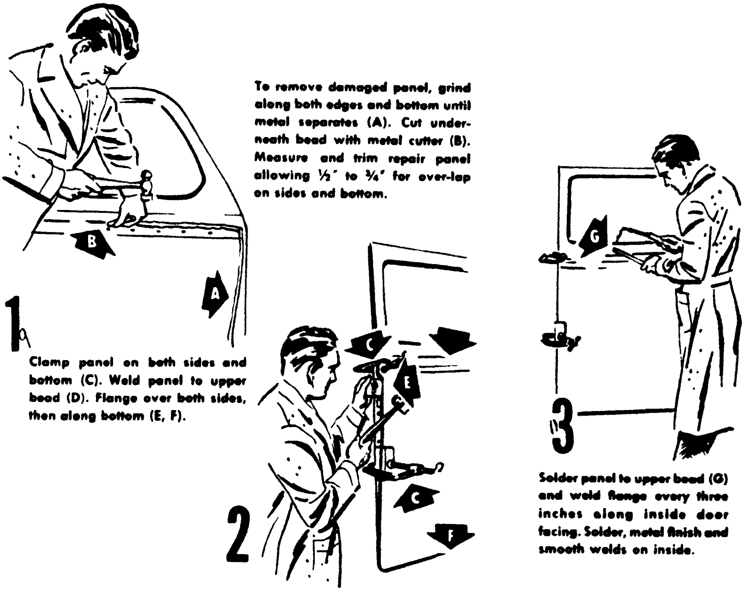
Trunks that have rusted through or, are otherwise damaged, can have an entire new section put in, as shown by the dotted lines in Fig. 91.

Roof Replacement

The step-by-step procedure for doing this work in a pleasing and profitable manner follows:

There are four basic requirements in putting on a roof panel, as we see in Fig. 92. With one of the body-rebulding jacks seen in illustration *1* of Fig. 92, square the body. Obviously all door and window openings must be properly aligned before the new panel goes into place.

As suggested in illustration *2*, a careful check must be made to leave enough of the old material so that the new panel can be properly attached. It's a good plan to lay the new panel on the roof and use chalk to mark the outline the new panel will cover. In cutting out the damaged roof, be sure to leave 3 inches of old material both front and back, as indicated by arrows *A* and *B*, and one inch of the old material above the drip moldings, as indicated by the arrow *C*. Should the extent of the damage be so great that the metal left is bent, it must be smoothed out with dolly and hammer so that the repair panel fits smoothly.



To remove damaged panel, grind along both edges and bottom until metal separates (A). Cut underneath bead with metal cutter (B). Measure and trim repair panel allowing ½" to ¾" for over-lap on sides and bottom.

Clamp panel on both sides and bottom (C). Weld panel to upper bead (D). Flange over both sides, then along bottom (E, F).

Solder panel to upper bead (G) and weld flange every three inches along inside door facing. Solder, metal finish and smooth welds on inside.

Fig. 93. The three steps in installing a door repair panel.

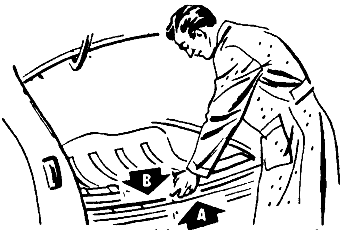
Step number *3* is to tack weld the four corners and the center of each edge into place using enough wet asbestos to protect paint and prevent buckling. It is then necessary to go all around the repair panel, welding it every two inches with ¼ inch welds, using either gas or arc welding equipment.

After this the overlap must be dinged down, thoroughly cleaned, and finished with body metal, as we see in illustration *4* of Fig. 92. Then the job is ready for painting.

Door Repairs

The three steps for replacing the damaged door panel are illustrated in Fig. 93.

1. At the upper left, the edges having been ground so that they separate as at *A*, the old panel is being cut off at *B* so that the new panel can be held in place and marked to allow ½ to ¾ inch of overlap on both sides and bottom.



Measure damaged surface (A). Measure repair panel Enough metal should be left in removing damaged section to allow repair panel to lap two inches on all sides (B)

Fig. 95. Measuring damaged surface prior to panel installation.

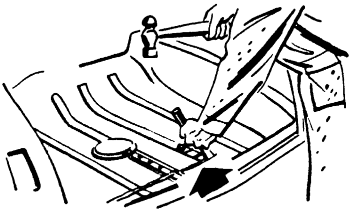
2. Using "C" clamps and wood blocks, the new repair panel is held in position on both sides and bottom, and is welded to the upper bead. With dolly block and hammer it is then flanged over on sides and bottom.

3. Finishing the top edge with body metal, as at *C*, and welding every 3 inches along the inside facing, finishes the torch work. Metal finishing and smoothing prepares it for the paint department.

Trunk Repairs

The steps for replacing luggage compartment panels follow the same basic procedures just given.

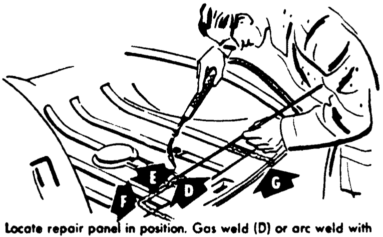
To square the trunk door opening, before installing the repair panel, measure from one trunk hinge bolt to the body bolt on the opposite side of the body near the X brace. Then measure the opposite diagonal and apply the necessary force with a jack. It is of utmost importance to remove the gasoline tank as a safety measure before doing this job.



Caution: Before starting this job be certain to remove fuel tank. Remove damaged section, using sharp edge cold chisel (C) or panel cutter.

Fig. 96. Cutting out luggage compartment panel.

As in any panel replacement, the damaged surface, indicated by *A* in Fig. 95, should be measured and enough of the old material left to provide overlap for the new panel. Two inches is recommended on all sides.



Locate repair panel in position. Gas weld (D) or arc weld with ¼" welds where repair panel laps floor—at both ends and rear (E, F, G). Smooth out with hammer and dolly block. Paint both sides to prevent rusting.

Fig. 97. Welding in luggage compartment repair panel.

With a panel-cutting tool and hammer, or even a sharp cold chisel, the old panel is cut out, as shown in Fig. 96.

With the new panel in place, as in Fig. 97, the edges are welded securely. After this any roughness is smoothed out with hammer and dolly block, and the job painted to prevent rusting.

CHAPTER XIII

MAJOR BODY REPAIRS

Since most body work is made necessary by accidents that apply a destructive force to the car, it is self-evident that to correct the damage requires the application of a force in the opposite direction to the original and destructive force.

Easily said—but not quite so easily done. While jacks, crow bars, ungainly planks, and other makeshifts have been used for years in an attempt to force damaged frames and bodies back into shape, it was not until a few years ago that a truly portable yet impressively powerful piece of equipment for this work was developed.

The equipment referred to is known to the trade as Porto-Power and, briefly, is a hydraulic cylinder connected to a pump by means of a flexible tube. It makes the power of a hydraulic jack available in tight places since the cylinder in which the force is created is not in the job, but along side of it on a stand. Of course there is much more to it than the foregoing, for various attachments for applying force on all kinds of surfaces and at any angle without damage to the job are included. So, too, are attachments for frame straightening; and most really bad body jobs require frame work.

As a means of seeing just how this piece of equipment does the work let us look at the following diagrams and then at some actual shop photographs showing it on the job. First of all it is necessary to know what is out of line before we can align it. So in Fig. 99 an approved way of checking a frame is shown. Misalignment is usually checked by observation, but measurements are more accurate. Measurements are taken from points that are common to both sides of a section of a frame. Measurements *A-B* will equal *A′-B′* in Fig. 99, and so on if the frame is true. Measuring by sections is easier than trying to check the whole frame at once and determines just where misalignment exists.

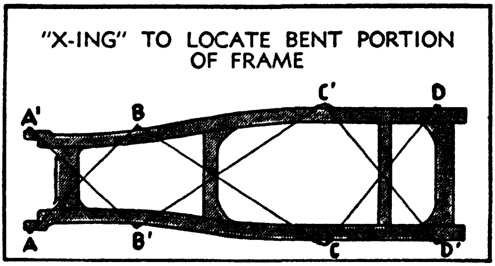


Fig. 99. Checking frame alignment.

Checking Door Openings

Misalignment of a door opening is generally checked by the fit of the door but may be checked as shown in Fig. 100. Here measurements are taken by marking off a certain number of inches along door post from *B* to *A* and along the door sill from *B* to *C*. Then the diagonal from *A* to *C* is measured accurately. Comparison of the measurements between a damaged side of the car and an undamaged side will show up misalignment.

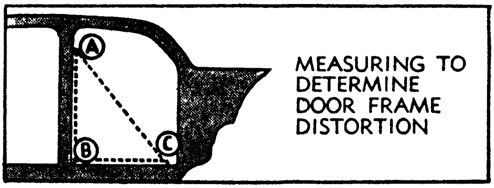


Fig. 100. Measuring door distortion.

Determining Body Distortion

Fig. 101 shows a good way of checking body distortion by "X-ing," that is, measuring diagonally across the body and comparing the dimensions. In this kind of check-up *A-B* should equal *A'-B'* and *C-D* should equal *C'-D'*.

Applying the Corrective Force

Ways of applying the corrective force required to straighten bent frames and bodies are seen in the following diagrams. Note that in each instance the force is applied directly opposite to the force that caused the damage. In the frame work shown in Fig. 102 special fittings and a chain secure Porto-Power where it will prove most effective. But

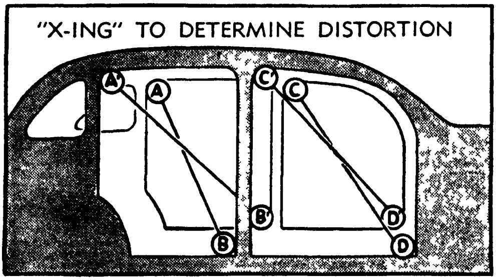


Fig. 101. "X ing" for body distortion.

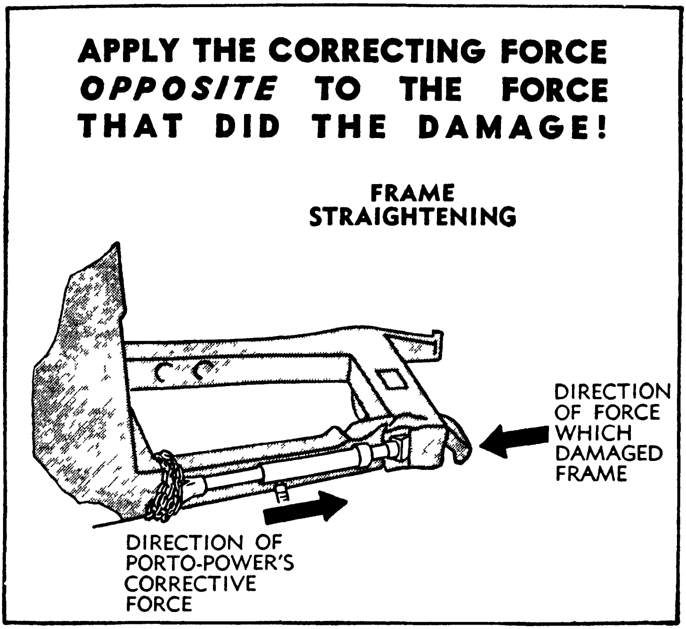
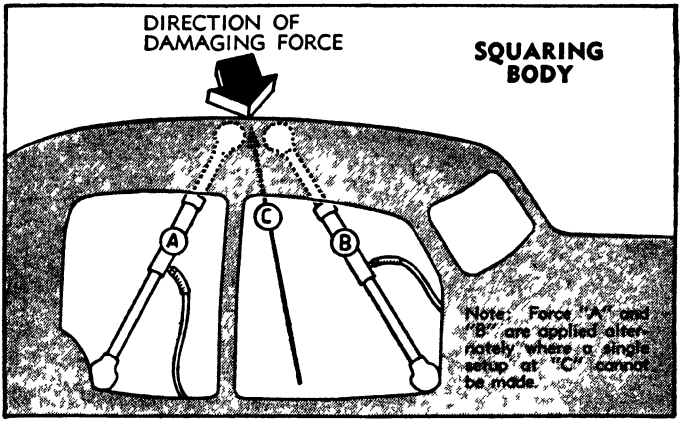

APPLY THE CORRECTING FORCE *OPPOSITE* TO THE FORCE THAT DID THE DAMAGE!
FRAME STRAIGHTENING
DIRECTION OF FORCE WHICH DAMAGED FRAME
DIRECTION OF PORTO-POWER'S CORRECTIVE FORCE

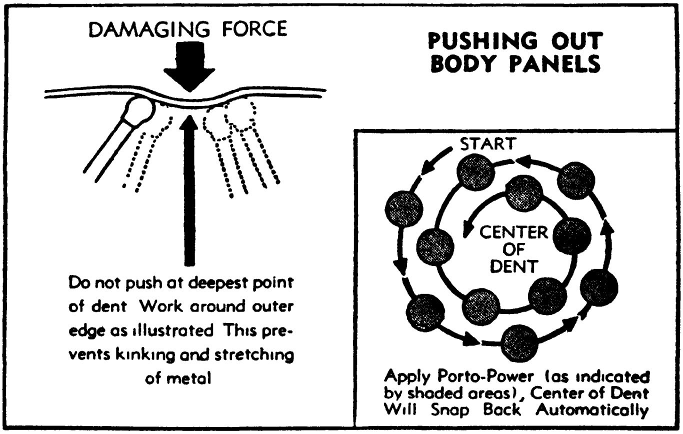
Fig. 102. Applying frame straightening force

in Fig. 103 rubber ball ends, called "flex-heads" are used and Porto-Power holds itself in place as soon as it is "pumped up" to full length. In Fig. 104, the method of forcing out a dent by working around it gradually toward the center is seen.



Note: Force "A" and "B" are applied alternately where a single setup at "C" cannot be made.

Fig. 103 Squaring a body.



Do not push at deepest point of dent Work around outer edge as illustrated This prevents kinking and stretching of metal

Apply Porto-Power (as indicated by shaded areas), Center of Dent Will Snap Back Automatically

Fig. 104. Pushing out panels.

Squaring a Body

Figs. 105 and 106 show two operations in squaring a body. A flex-head is used to push against the roof rail from two

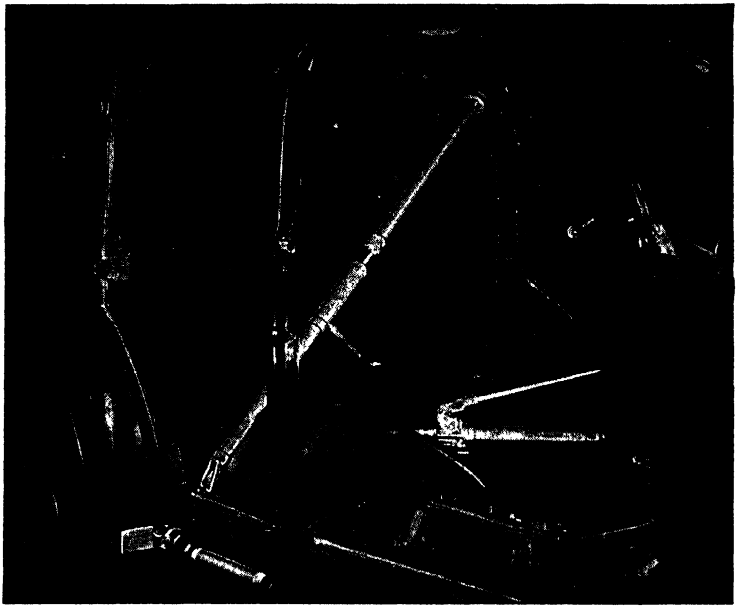


Fig. 105. Pushing out left of body.

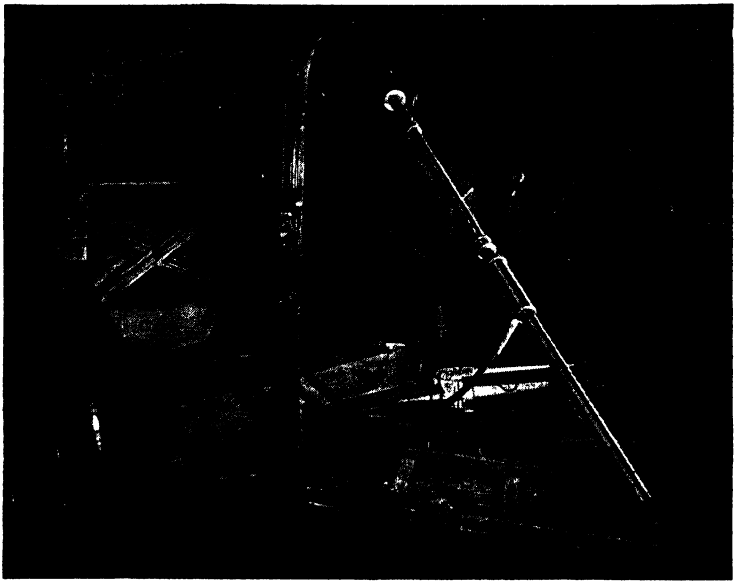


Fig. 106. Pushing left of body back.

different angles. In Fig. 105, at the lower end of the equipment, will be seen an offset wedge while in the corresponding position in Fig. 106 is a flex-head. In this latter position anchorage is obtained against the bottom of the front-door pillar, while in Fig. 105 anchorage was had against a bolt head.

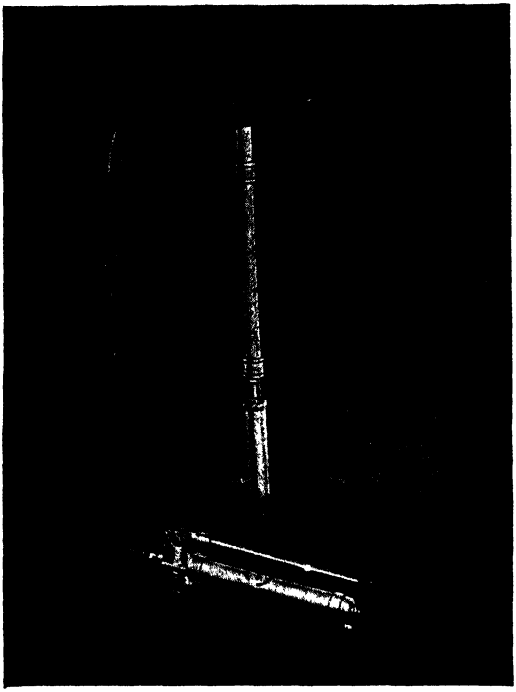


Fig. 107. Forcing up dent in steel roof.

Straightening Steel Tops

With steel tops practically universal, Figs. 107 and 108 prove interesting, for they show dent removal in these parts. Fig. 107 shows the equipment performing as shown in the diagram of Fig. 104, the flex-head being worked around the dent gradually bringing the pressure over to the center in order not to stretch the metal. In Fig. 108 a plank is being used with Porto-Power to force up a large section of caved-in roof. Other uses are seen on the following pages.

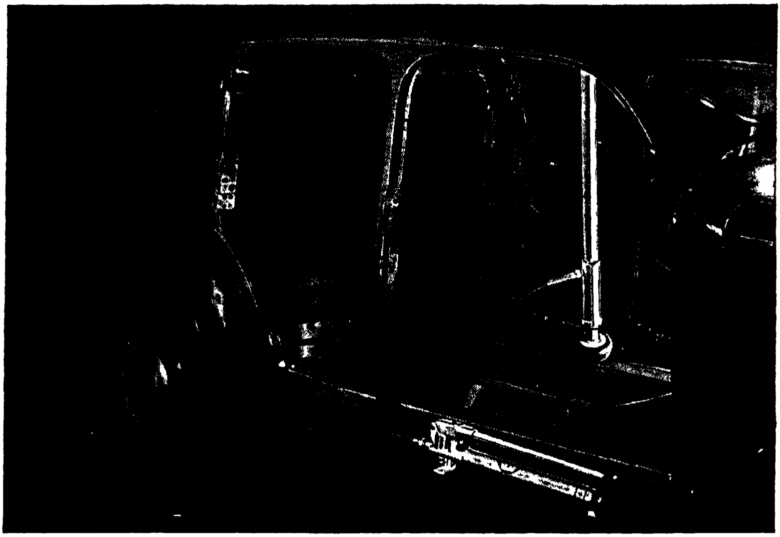


Fig. 108. Raising large area of steel roof.

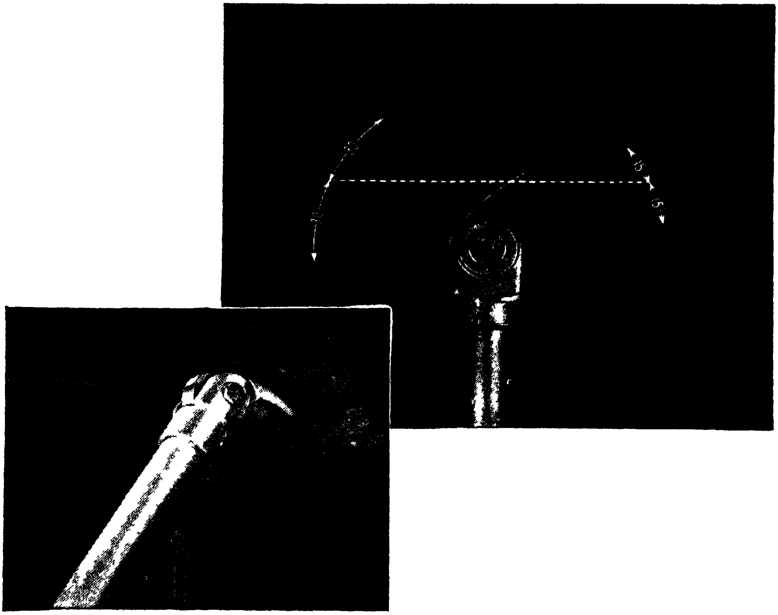


Fig. 109. (Right) Adjustable spoon. (Left) Application of equipment using spoon.

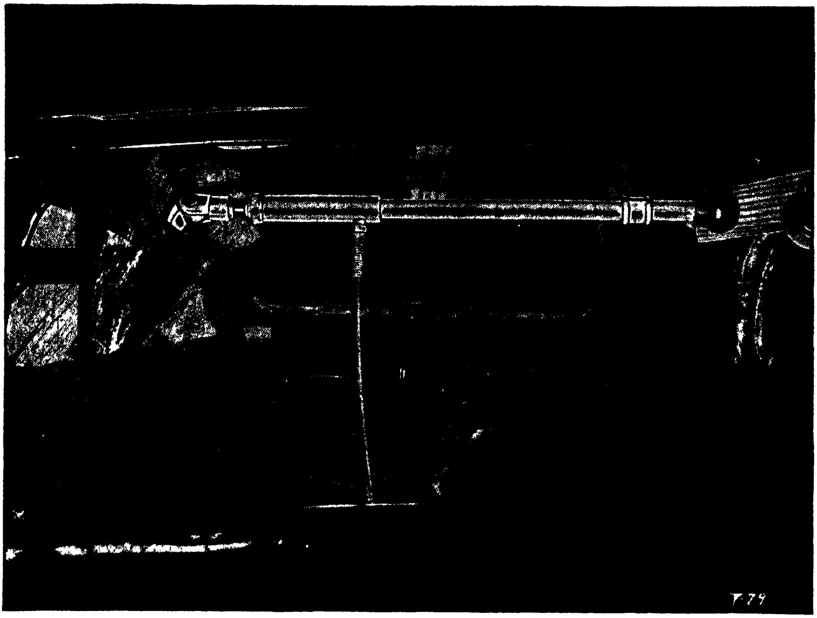


Fig. 110 Pushing out a rear quarter panel

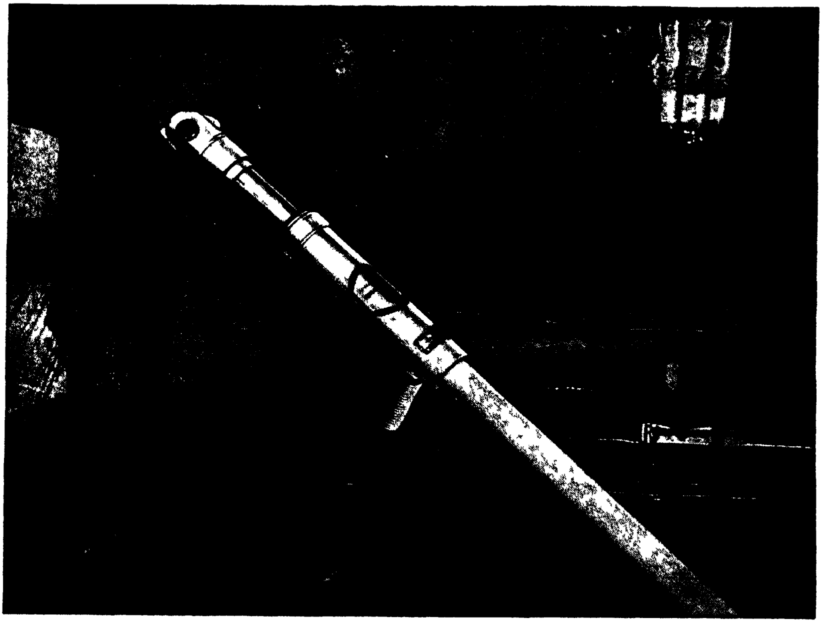


Fig. 111. Spoon getting anchorage behind a rail.

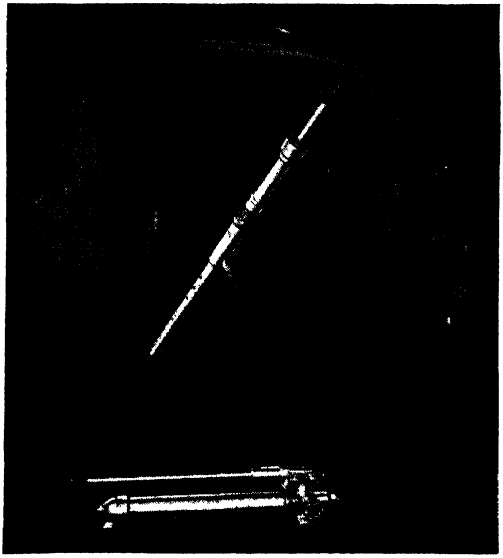


Fig. 112. Forcing out a door opening.

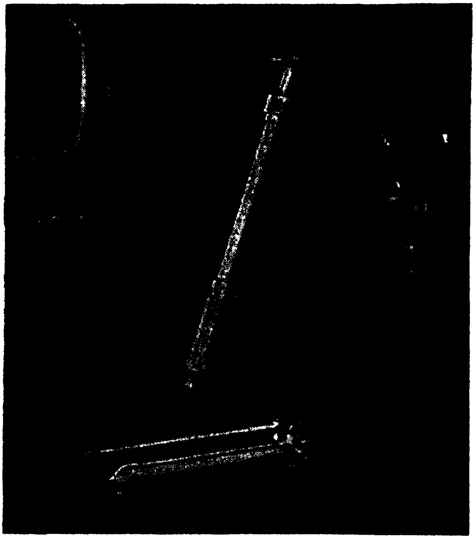


Fig. 113. Raising door frame.

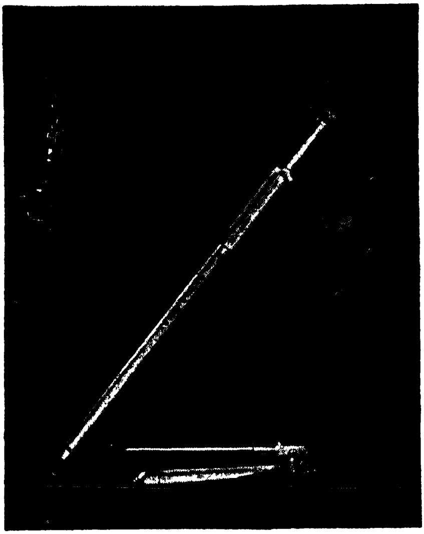


Fig. 114. Forcing curved portion out.

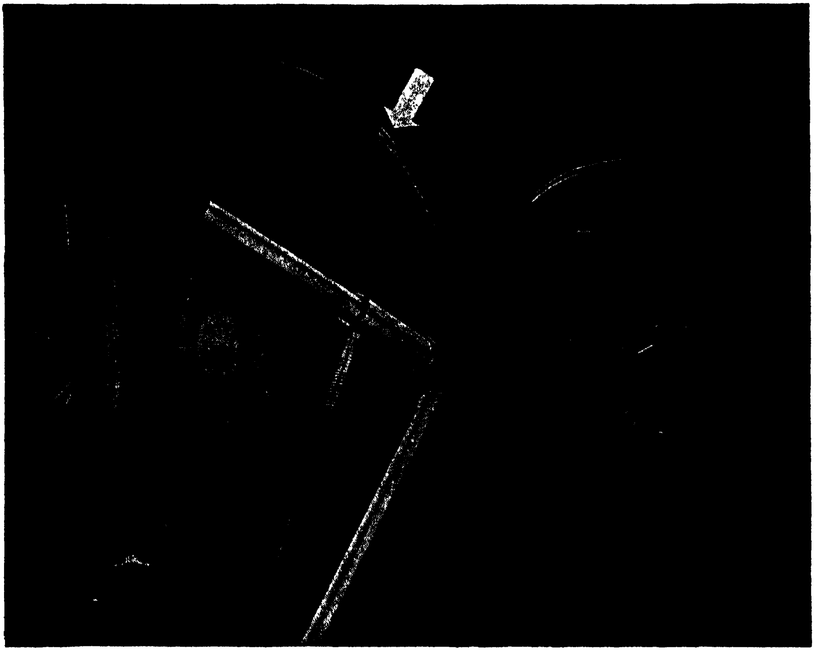


Fig. 115. Drawing curved portion in.

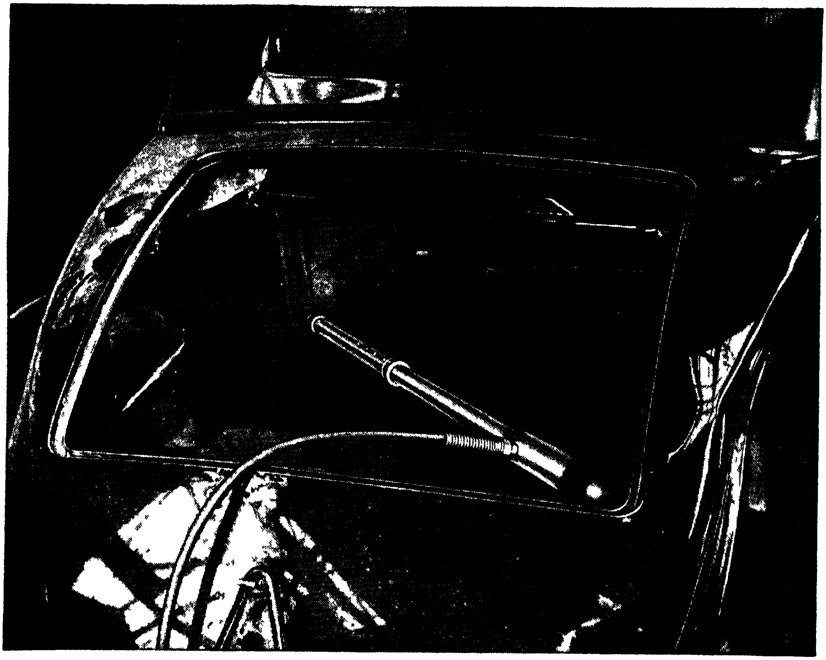


Fig. 116. Squaring rear deck opening.

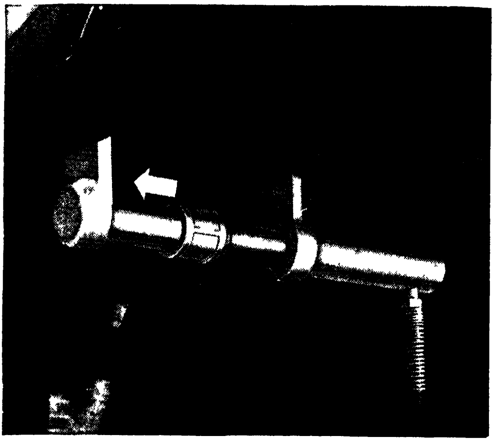


Fig. 117. Pushing out rear header structure.

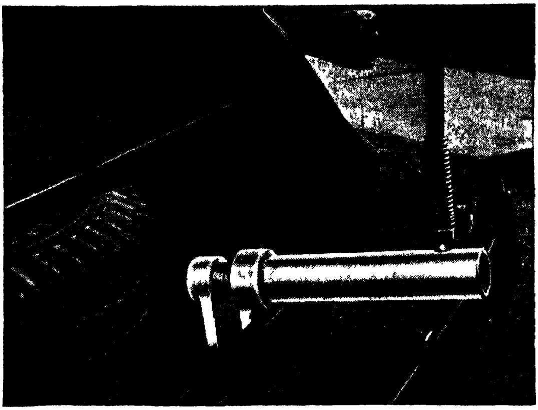


Fig. 118. Pulling out rear of body.

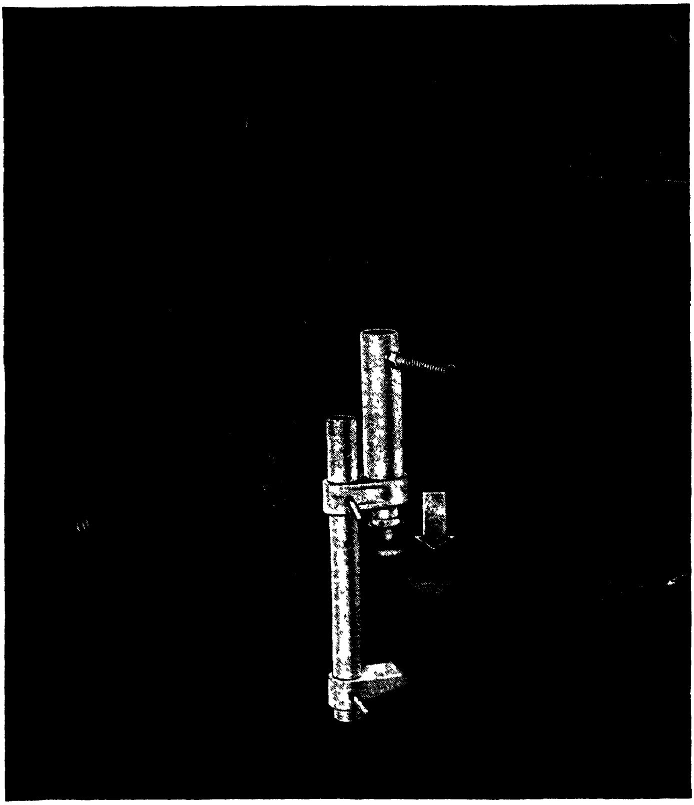


Fig. 119. Forcing floor into line.

Pushing Out Caved-in Panels

The spoon shown in detail in Fig. 109 is used along roof rails and similar places, the application being well shown in the lower left portion of Fig. 109. This spoon may be reversed where panel contour makes this desirable, its various positions being indicated by dotted lines in the illustration. Fig. 110 shows the set-up for pushing out a rear quarter panel. Note that the spoon has slipped in behind the bracket at the left, a flex-head resting against a 2 × 4 completing the set-up on the other side of the car. Fig. 111 shows a some-

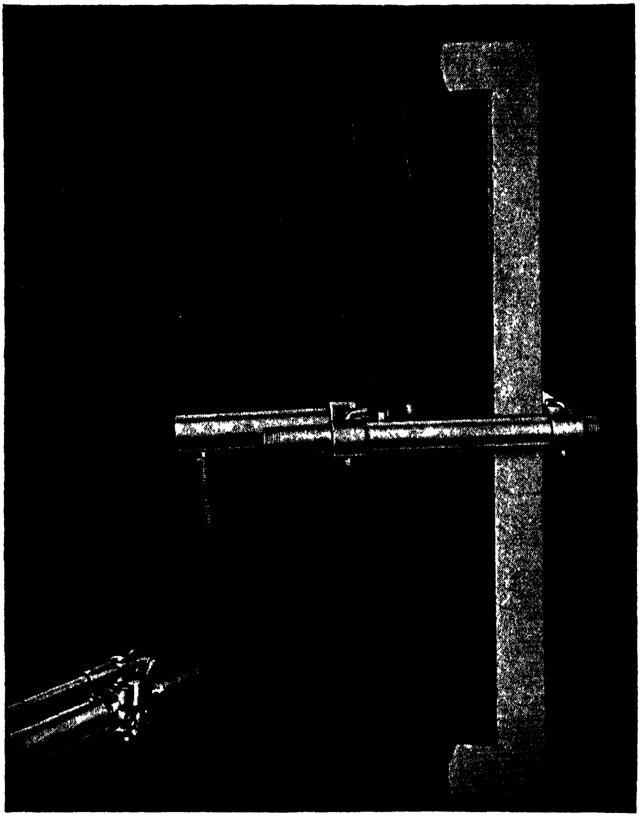


Fig. 120. Correcting curve of door.

what different application in which the spoon goes behind the end of the roof rail and pushes the quarter panel at the desired angle. The set-up is anchored against the bottom of the rear door pillar.

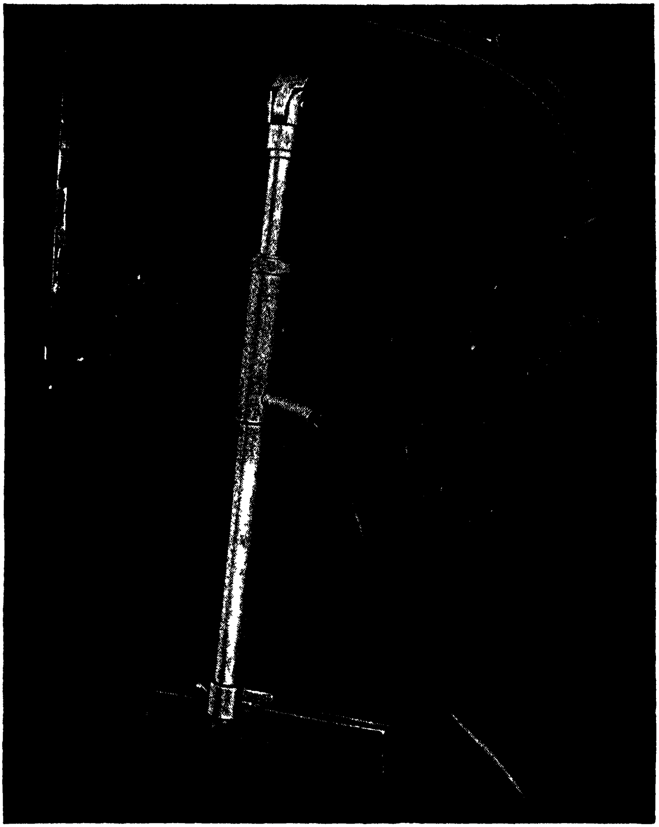


Fig. 121. Straightening window frame in door.

Straightening Door Frames

Lining up a door frame with an angular push is shown in Fig. 112 while Fig. 113 shows the set-up for raising the door frame. Fig. 114 is still another door-aligning operation, this being a job of squaring the opening. Where it is necessary to pull down a door frame as indicated by the arrow in Fig. 115 a triangular set-up is used as shown, the pressure drawing down the portion indicated by the arrow.

Odd Body Jobs

Should it be necessary to square the rear deck opening, the set-up used is shown in Fig. 116. With "spreader toes," as the manufacturer calls them, Porto-Power is able to force

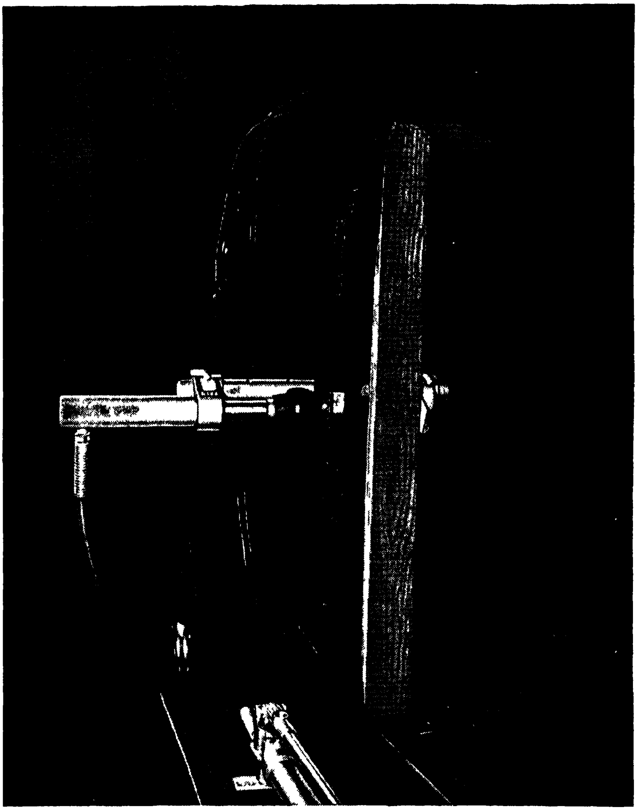


Fig. 122. Straightening door post.

out tight places such as the job on the rear header seen in Fig. 117 or a tighter place as shown in Fig. 118. Still another odd application is shown in Fig. 119 in which the floor is being pushed down to the frame by means of special fittings

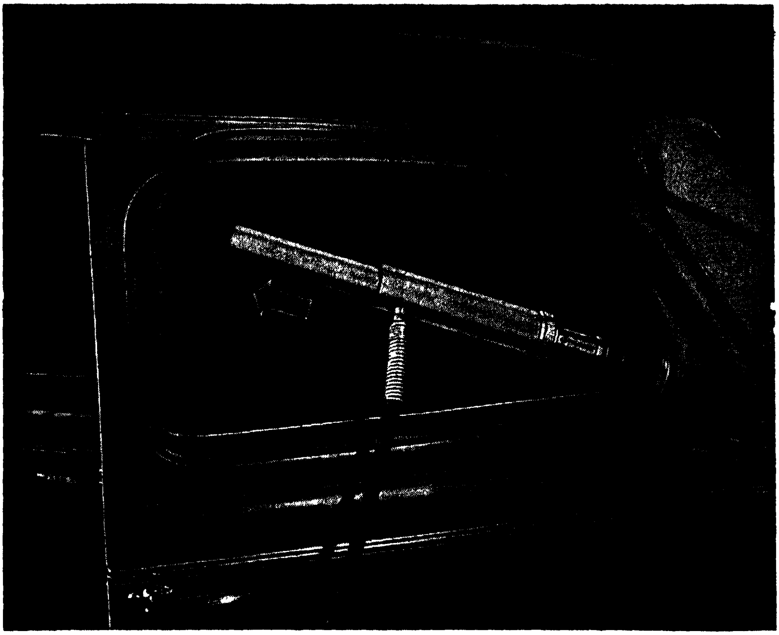


Fig. 123. Straightening window frame.

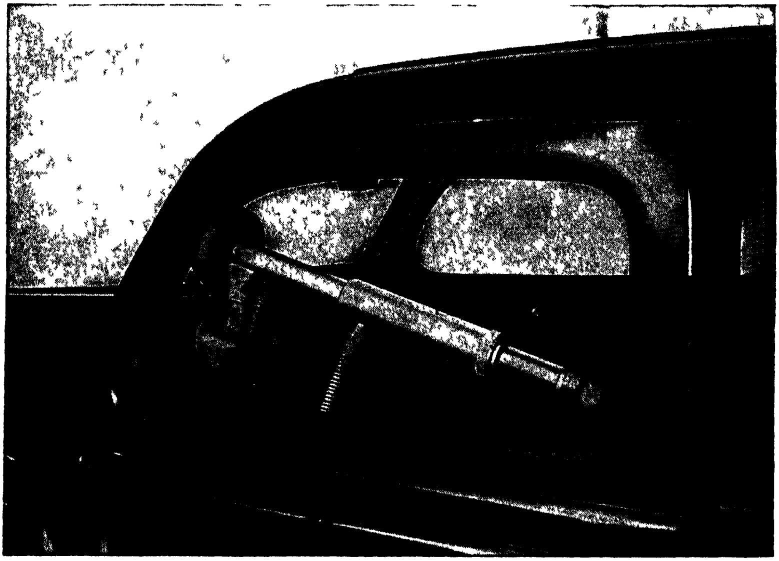


Fig. 124. Using prop on steep angle.

as illustrated. Increasing door curvature is accomplished by a combination of forces illustrated in Fig. 120. A simple wood beam is constructed for this work and used with the equipment as shown. To concentrate force at a point, the equipment is used as shown in Fig. 121—a block at the end where the effect is not wanted and a spoon at the other end. A sprung door post is handled as seen in Fig. 122—a heavy beam and the forcing equipment completing the job. To line up a window frame, an application such as the one in Fig. 123 will force the job as indicated by the arrow, for the lower end of the equipment rests against a more solid part of the door. But if the angle is so steep that the flex-head slips, then a second one may be put on as a prop, as seen in Fig. 124. And for a longer job, an extension as seen in Fig. 125 will reach all the way across a windshield.

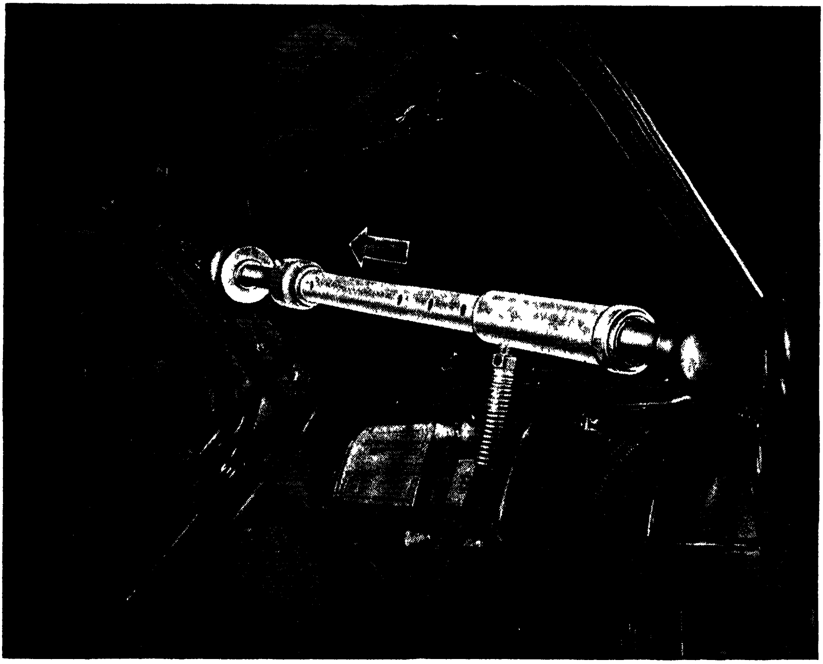


Fig. 125. Straightening windshield frame.

CHAPTER XIV

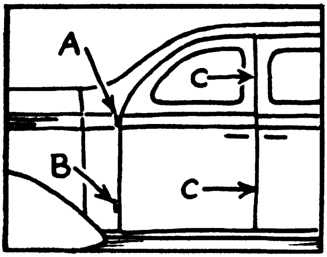
SERVICING DOORS

Barring wrecks most door-fitting today is accomplished by springing the hinges, relocating the dovetail or adjusting the door bumpers and latch. As the Budd Body Company points out, all doors and the frames they fit on modern cars are sheet steel, die stamped. Dies cannot stamp two pieces of different size; therefore all doors and their frames are of uniform size and cannot be misfits regardless of how combined. An accident is the only thing that can alter the fit of a door in its frame. No matter how long the automobile is driven, distortion, decay, or warping cannot alter the door fit. It follows then that any adjustment to be made must of necessity be made in the door accessories: hinges, dovetails, striker plates and rubber bumpers, rather than in the door unit itself. When adjusting doors, one of the door bumpers should be removed and the door fitted snugly against the remaining one, after which the door bumper can be replaced in such a manner that it is slightly compressed when the door is closed. Fitting bumpers in this manner often eliminates the necessity of springing the door to close it.

CAUTION: When adjusting doors always apply pressure gently.

Rubbing Doors

In Fig. 126, the door is shown as rubbing against the post at the two points *C*. To correct this condition unfasten door checks. Then, opening the door to its fullest extent, exert pressure gently at points *D* (Fig. 127) which will spring hinges *A* and *B* (Fig. 127). This will spring the door away from the post and relieve rubbing. When the door does not close tightly at the top (point *A* in Fig. 128) and closes snugly against the post at the bottom (*B*), place a block, covered with a rag to protect the trim and paint between the bottom of the door and the post (point *E* in Fig. 129) and press gently the top of the door at point *D* until the door springs enough to correct the condition. If the door is found to be closing tight at the top and open at the bottom, simply reverse the method of repair. In Fig. 130, the door is shown as binding against the post at point *A*, too far away from the post at point *D*, moldings out of line at point *F*, and with the opening between the doors, points *B* and *C*, not uniform. To correct this condition, place a screw driver between the hinge leaves of the hinge (point *G* in Fig. 131) and close the door gently. Applying pressure at point *H* (Fig. 131), will cause the hinge to open, throwing the door away from the post at point *A* and dropping the



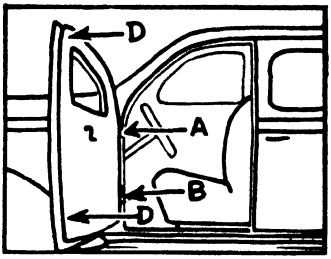
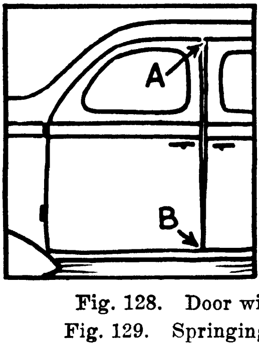


Fig. 126. **Door rubbing against post.**
Fig. 127. Springing door hinges.



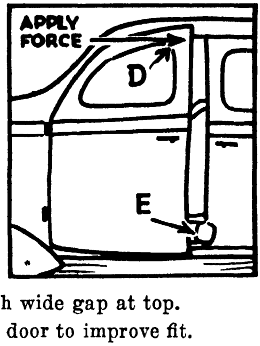
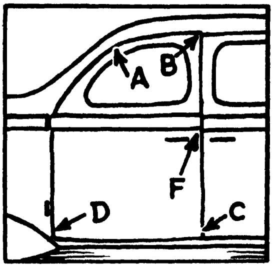


Fig. 128. **Door with wide gap at top.**
Fig. 129. Springing door to improve fit.

rear of the door to make the clearance uniform and bring the moldings into alignment. If the door is binding at point *D* reverse the operation by placing the screw driver between the hinge leaves of the lower hinge.



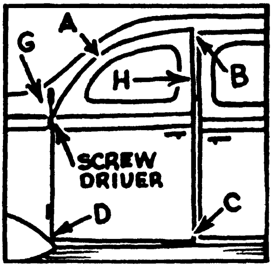


Fig. 130. Door with molding out of line at F.
Fig. 131. Applying pressure at H to improve alignment.

A departure from ordinary door mounting is seen in the 1938 Buick cars. The doors to these cars use no rubber side bumpers. A sponge weatherstrip (Fig. 132) runs around the door from sill to sill, secured to the door facings with metal clips and sealed with cement. The metal clips are thrust through small holes that are provided in the door facings and they hold by clinching.

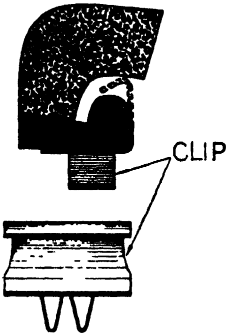


Fig. 132. Section of weatherstrip surrounding doors on '38 Buicks.

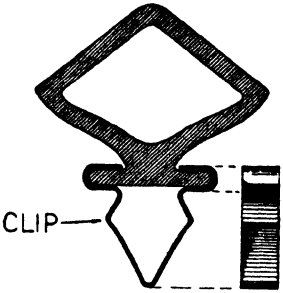


Fig. 133. Weatherstrip at bottom of doors on Buick models 40-46.

The weatherstrip compresses against the outer edge of the body aperture when the door is closed and serves to effectively seal the opening against drafts or leaks, as well as to cushion the door as was formerly done by the side bumpers.

The tightness of the door fit to these weatherstrips can be controlled by adjustment of the striker plate and door hinges as described in succeeding paragraphs.

On Series 40 and 60, a soft hollow weatherstrip (Fig. 133) is attached across the bottom of the door and compresses against the door rocker panel to prevent air drafts from below.

On Series 80 and 90, a new type of door bottom weatherstrip is used (see Fig. 134). The lip of this weatherstrip is pushed inward by the lower edge of the door, sealing the opening effectively.

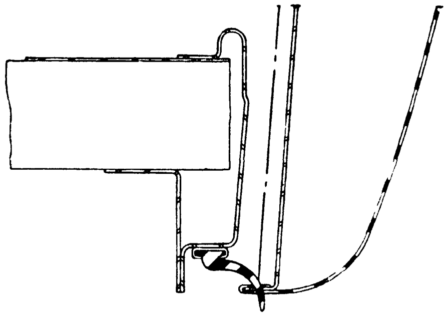


Fig. 134. Lip type weatherstrip on Series 80 and 90 Buick cars at bottom of doors.

The inside edge of the door aperture is further sealed by a windlacing attached to the body which presses against the door in its closed position.

Rubber bumpers are mounted on the upper part of the lock pillar to prevent metal-to-metal contact of upper door flange and body.

The door hinges are attached to the body hinge pillars and door hinge pillars with cap screws threaded into the hinges, secured by lock washers (see Fig. 135). The holes in the body pillars are elongated vertically to permit adjustment of the door upward or downward in the door aperture.

The holes in the door pillars are elongated horizontally to permit adjustment of the door inward or outward.

The striker plate is secured to the lock pillar by means of two machine screws threaded into a movable nut-plate set within the pillar. The holes in the pillar are slotted horizontally, permitting the striker plate to be moved in or out so as to secure proper fitting of the door within the aperture.

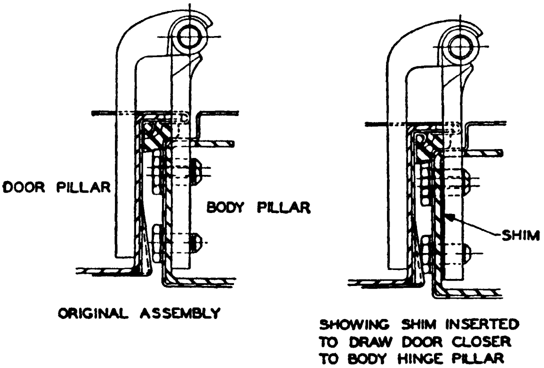

DOOR PILLAR
BODY PILLAR
SHIM
ORIGINAL ASSEMBLY
SHOWING SHIM INSERTED TO DRAW DOOR CLOSER TO BODY HINGE PILLAR

Fig. 135. Hinge design showing shim adjustments.

Dovetail Bumper Assembly

The dovetail bumper assembly is built into the lock pillar, the shoes being covered with a casing cap secured to the pillar with machine screws. Removal of the casing cap will permit adjustment or replacement of the shoes.

An adjustable dovetail wedge plate is used which may be moved higher or lower to cause it to enter centrally into the dovetail assembly (see Fig. 136). The wedge plate is serrated to its base and has elongated holes through which the two screws enter, thus allowing it to be adjusted to fine measurements.

Door Check

The maximum swing of the door is controlled by the door check which is located just above the lower hinge, and is comprised of a rod hinged to the door, guided in the hinge pillar, and fitted with a rubber bumper on the inner end. Adjustment is accomplished by screwing the rubber bumper in or out on the threaded portion of the rod, after removing the trim from the face of the hinge pillar.

Should a squeak develop in this door check, align it for clearance and give the rod a light application of soft soap, then open and close the door three or four times. This will carry the soap to the rubber guide on which the rod slides.

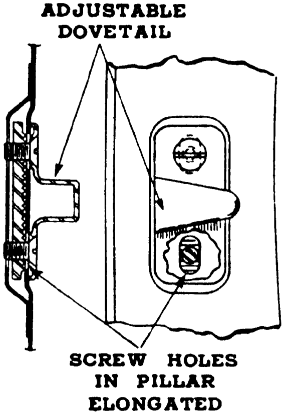


Fig. 136. Adjustment of dovetail.

Aligning and Refitting Doors

Barring an accident, a door will remain in shape almost indefinitely. When a door fits the door opening poorly, it is either improperly hinged to the body hinge pillar, which will show at the vertical spacing on the hinge side of the door, or the door opening is out-of-true, usually by reason of improper shimming of the body on the chassis.

Alignment of Rear Doors

To align the doors of a body correctly, when one or all the doors are fitting poorly, the body workman should start by checking the vertical spacing at the hinge side of the rear door. To do this proceed as follows:

1. Remove the door wedge plate.
2. Make sure all hinge screws are tight.
3. Close door and check vertical spacing, making sure it is equal from top to bottom.

This spacing may vary from 3/32 inch to 1/4 inch on different bodies, but it should be fairly equal at all points. If necessary, the spacing may be reduced by inserting a shim between the body hinge half and the body hinge pillar (see Fig. 135). Thin washers inserted at this point on the hinge cap screws will have the same effect.

Alignment of Front Doors

After the rear doors are in correct vertical alignment, the front doors are aligned in a similar manner.

Figs. 137, 138 and 139 represent three different conditions of front door misalignment commonly met with in body shop work. Each is a problem to be solved before its correction is attempted.

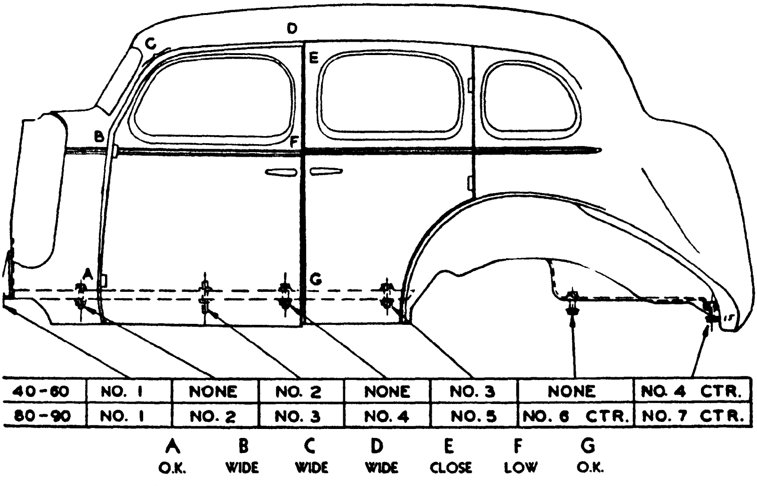
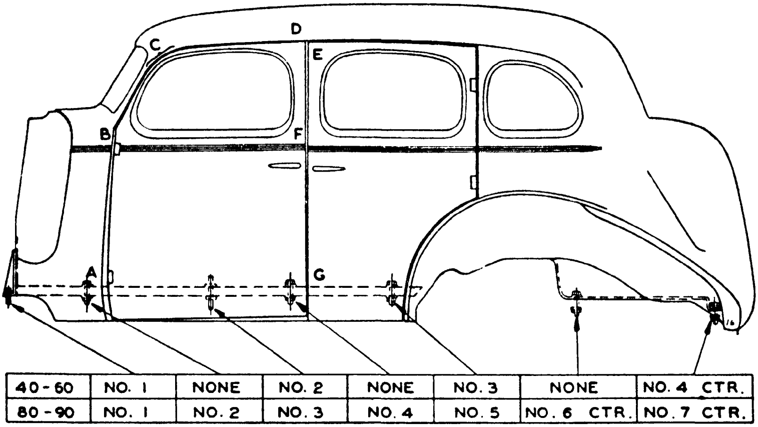

D
C
E
B
F
A
G
40-60 | NO. 1 | NONE | NO. 2 | NONE | NO. 3 | NONE | NO. 4 CTR.
80-90 | NO. 1 | NO. 2 | NO. 3 | NO. 4 | NO. 5 | NO. 6 CTR. | NO. 7 CTR.
A O.K.
B WIDE
C WIDE
D WIDE
E CLOSE
F LOW
G O.K.

Fig. 137. Body shimming to reduce space at B.

In each of these diagrams, as well as in Figs. 140, 141 and 142 it is assumed that the rear door has been aligned vertically as instructed, and the work yet to be performed involves only the front door, and the horizontal alignment of the two doors at the belt molding. Therefore, all these diagrams and the corrections indicated are applicable alike to four-door sedans, two-door sedans, and coupes.

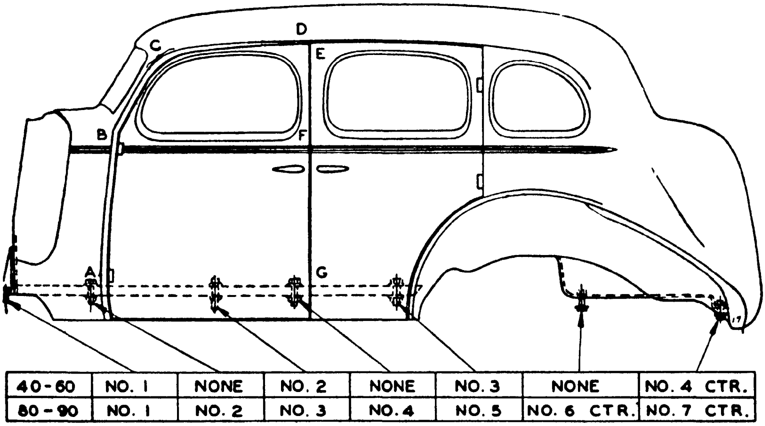
Figs. 140 and 141 represent two extremes cases of front door trouble. In either case the door opening is so distorted



40-60	NO. 1	NONE	NO. 2	NONE	NO. 3	NONE	NO. 4 CTR.
80-90	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6 CTR.	NO. 7 CTR.

A	B	C	D	E	F	G
WIDE	O.K.	CLOSE	CLOSE	O.K	HIGH	CLOSE

Fig. 138. Body shimming to reduce space at *A*.



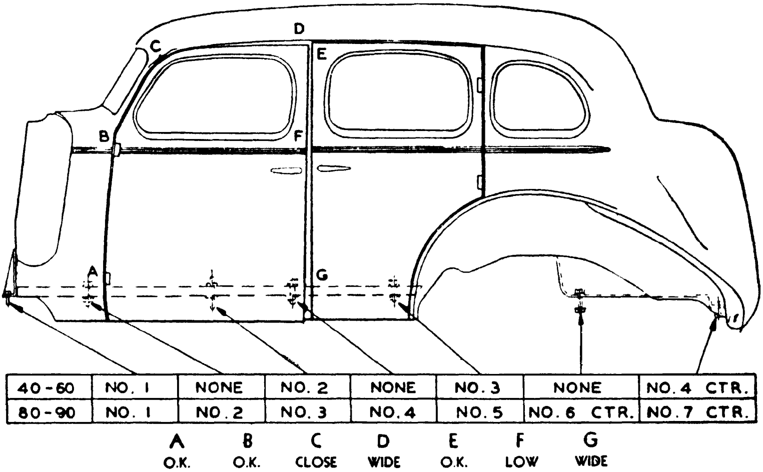
40-60	NO. 1	NONE	NO. 2	NONE	NO. 3	NONE	NO. 4 CTR.
80-90	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6 CTR.	NO. 7 CTR.

A	B	C	D	E	F	G
WIDE	WIDE	WIDE	O.K.	CLOSE	O.K.	CLOSE

Fig. 139. Body shimming to reduce space at *A* and *B*.

that a special operation is necessary to make the door fit the opening properly. These cases will seldom be encountered in the field.

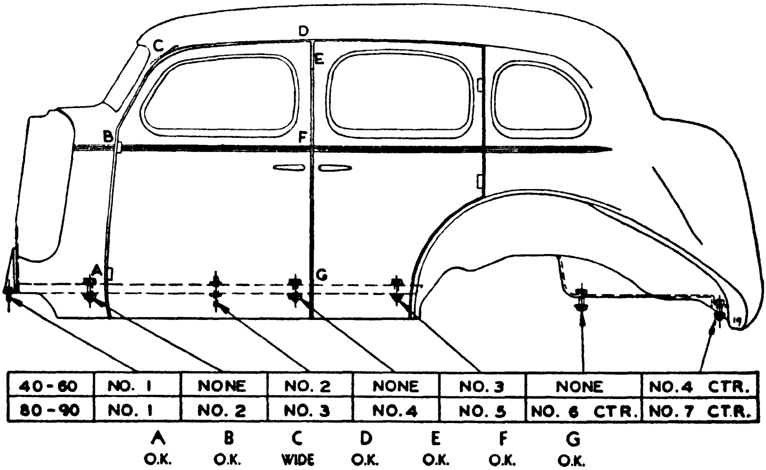
In Figs. 139 and 141, both front and rear doors are perfectly aligned and no body shimming is necessary.



40-60	NO. 1	NONE	NO. 2	NONE	NO. 3	NONE	NO. 4 CTR.
80-90	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6 CTR.	NO. 7 CTR.

A	B	C	D	E	F	G
O.K.	O.K.	CLOSE	WIDE	O.K.	LOW	WIDE

Fig. 140. Body jack is used diagonally across body to increase space at *C* with body shimmed as necessary.



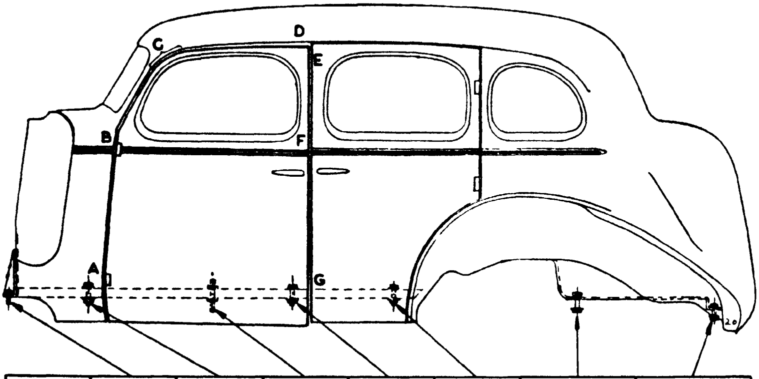
40-60	NO. 1	NONE	NO. 2	NONE	NO. 3	NONE	NO. 4 CTR.
80-90	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6 CTR.	NO. 7 CTR.

A	B	C	D	E	F	G
O.K.	O.K.	WIDE	O.K.	O.K.	O.K.	O.K.

Fig. 141. Door flange can be built up at *C* with solder to correct contour.

Body Shimming

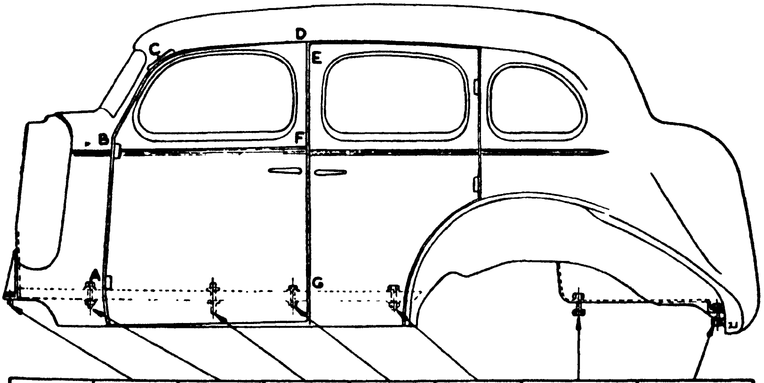
Figs. 142 and 143 represent two cases requiring only body shimming to correct. In either case both front and rear doors are in correct vertical alignment. These diagrams



40-60	NO. 1	NONE	NO. 2	NONE	NO. 3	NONE	NO. 4 CTR.
80-90	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6 CTR.	NO. 7 CTR.

A	B	C	D	E	F	G
O.K.	O.K.	O.K.	WIDE	O.K.	LOW	O.K.

Fig. 142. Condition here is corrected by increasing shims at No. 1 in series 40-60 series and at Nos. 1 and 2 in series 80-90 jobs.



40-60	NO. 1	NONE	NO. 2	NONE	NO. 3	NONE	NO. 4 CTR.
80-90	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6 CTR.	NO. 7 CTR.

A	B	C	D	E	F	G
O.K.	O.K.	O.K.	CLOSE	O.K.	HIGH	O.K.

Fig. 143. To correct this condition increase shims at Nos. 2 and 3 bolts for series 40-60 and Nos. 4 and 5 bolts for series 80-90 or decrease shims at front body bolts.

indicate typical conditions of doors shown in Figs. 137, 138, and 139 after the vertical alignment operations have been completed.

Briefly stated, the rules are as follows:

1. To raise the lock side of the door, a thicker shim should be installed at or near the hinge pillar on which that door is hung, or a thinner shim should be installed at or near the lock pillar.
2. To lower the lock side of the door, a thinner shim should be installed at or near the hinge pillar on which that door is hung, or a thicker shim should be installed at or near the lock pillar.

The directions for door alignment here given, if followed carefully, will align any ordinary set of doors. It must be remembered that checking for alignment should start at rear door always.

After door alignment and shimming operations have been completed, the door wedge plate may be reinstalled, and the fit of the wedge plate in the dovetail bumper casings checked carefully.

Shimming Convertible Bodies

The foregoing diagrams illustrate 1938 closed models only. The 1938 convertible bodies are shimmed and bolted to the chassis frame in the same manner as the corresponding 1937 models, except that the body bolt at the wheelhousing, that is, the bolt next to the rearmost bolt, has been omitted on each model.

Drafts and Dust Leaks

The high speed of today's streamlined cars, combined with modern ventilation, has a tendency to cause an indraft or suction of air into the body. This suction takes place at any unsealed opening or crevice, and is particularly in evidence at the door openings unless the doors are well fitted and aligned and the weather stripping properly adjusted.

In making corrections for drafts entering through the door openings, first check the doors for alignment and proper fitting within the openings and make any necessary adjustments.

Second, check the weather cord and weatherstripping around the doors for proper contact with the edges of the doors, and to ascertain if any part of the weather cord may be squeezed in the door opening, causing a hard-closing door and usually an air leak close by. Make necessary adjustments to the weather cords as may be indicated by this inspection.

Hard-Closing Doors

Hard-closing doors may be divided into two general classes; first, those doors which are only normally tight, the hard-closing being due to the comparatively large area of the door acting against the cushioning effect of the air within the body and, second, those doors which are hard-closing due to misalignment, undue friction or obstructions of some character.

The doors on late model cars are so large comparatively, and the body so well sealed, that the air cushion created when slamming the door shut is an appreciable factor to be considered. In particular, many women find it extremely difficult to close one of the large coupe or coach doors without first lowering the window or opening the ventilator to relieve the pressure within.

Therefore, in checking a hard-closing door, which appears at a casual glance to be properly aligned and fitted, it is well to slam the door shut, first with all windows and ventilators closed, and then with the door window lowered a few inches, to note the difference, if any, in operation. For, if this test indicates that the difficulty is due to air pressure only, no mechanical adjustments should be made, since any easing up of the door fit by adjustment of the hinges or striker plate will probably lead to a loose and noisy door in a short time.

In starting to work on a hard-closing door, it is assumed that the door is in correct alignment and properly fitted to the body so far as outward appearance may indicate. If not, the necessary operations should be performed to make it so, as described in the preceding sections.

Any one or several of the following items may be causing the hard-closing condition:

1. Weather cord or weatherstripping improperly fitted; catching and compressing between the door and door opening.

Correction: Examine weather cord and weatherstripping and adjust the same as necessary to clear door opening.

2. Door dragging on lock pillar or roof rail.

Correction: Examine outside edges of the door, front, top, and rear, as well as the adjacent surfaces of the opening, for bright or scraped spots, which would indicate a rubbing condition. If any such are found, the contacts must be eliminated by re-aligning door or peening metal away, or refitting screws, the heads of which may be projecting.

3. Wedge plate misaligned with dovetail bumper assembly.

Correction: Check fit of wedge plate in dovetail bumper casing. If a misaligned condition exists, it may be corrected by adjusting the wedge plate upward or downward.

4. Excessive pressure in dovetail bumper assembly.

Correction: If the wedge plate enters the dovetail bumper casing centrally, remove the wedge plate and check operation of door. An occasional dovetail bumper assembly may be encountered requiring an excessive pressure to close the door.

5. Door hinges misaligned or binding internally.

Correction: A misalignment of the hinges may be located by removing the lower hinge pin, dropping a wire nail in its place and operating the door. Both hinge pins should be examined for score marks which would indicate an internal binding condition.

If the foregoing instructions are carefully studied, and the operations carried out in the order indicated, no particular difficulty should be encountered in locating the cause of the trouble, and making proper adjustment.

CHAPTER XV

SERVICING LOCKS

Lock service can be divided two ways: the easiest and most frequently performed is that of cleaning and lubricating lock mechanism. Oil should never be used in locks. Oil is likely to gum or collect dust and cause sticking of the delicate lock mechanism. Nevertheless many car owners oil their own locks which make it necessary for the service man to clean them out. A pump type oil can filled with carbon tetrachloride or high-test gas can be used to flush out a lock. This breaks down, dislodges, and flushes out accumulated grease, oil, and dirt. Then, after waiting a minute or two for this cleaning liquid to evaporate or, better yet, after blowing the lock out with compressed air, a lubricating gun of fine graphite is used and a charge of this is forced into the lock mechanism. After having done the foregoing, the key should be inserted and moved slowly in and out to distribute the graphite over all moving surfaces.

The foregoing will put most locks into such condition that they will operate smoothly; but where it does not it is usually best to replace the entire lock cylinder with a new one, since repairs to the many parts that would be worn would cost more than the new cylinder.

Those interested in extensive servicing of locks would do well to write the Briggs and Stratton Corporation, Milwaukee, Wisconsin, for further information.

Replacing lock cylinders is generally accomplished in one of two ways. Either the cylinder is held by a retaining screw as shown in Fig. 144 and may be removed by loosening the screw, or in the constructed illustration in Fig. 145. Here the key is inserted and turned to the left while a sharp instrument (a paper clip will do) is inserted in a small hole in the cylinder to depress a retaining spring. The key is then further turned to the left and the cylinder removed with the key. The following information on key service covers specifically Briggs and Stratton locks used on 1938 Chevrolets (but applies to many other cars, too) and is from *Chevrolet's 1938 Shop Manual.*

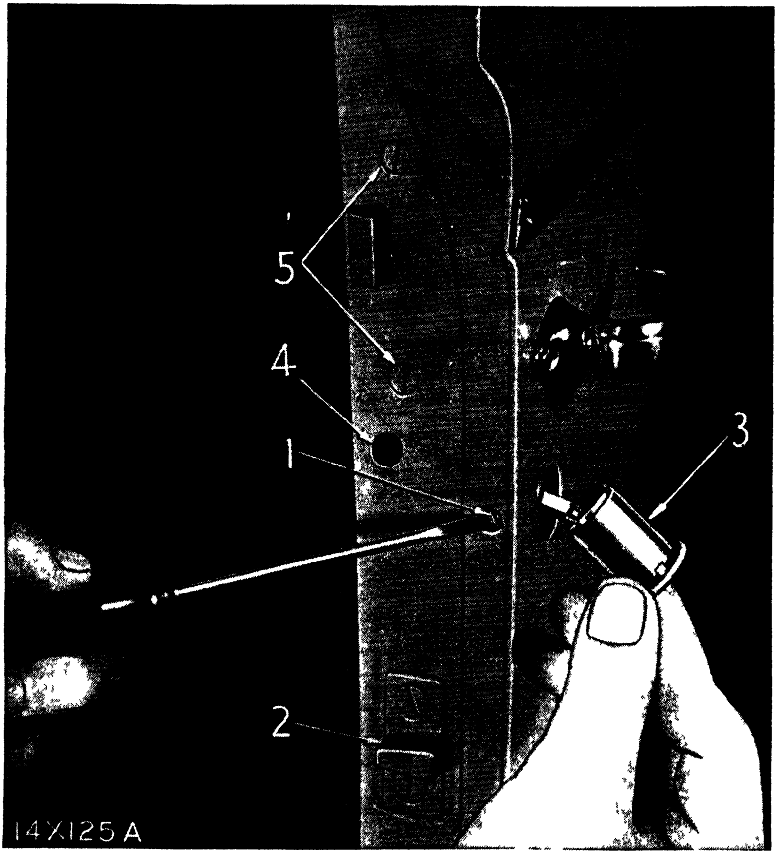


Fig. 144. No. 1 indicates the set screw that holds lock cylinder No. 3.

The side bar type lock is used on all 1938 passenger cars for the ignition, door, and deck. This lock has six tumblers cut to four different depths. Service locks have the tumbler depths indicated by colors, "B" for black, "N" for nickel, "Y" for yellow, and "C" for copper. Key codes, furnished with all key-cutting machines, consist of numerals for the tumbler positions and letters for the tumbler depths.

To assemble tumblers in an uncoded lock cylinder:

First, hold cylinder in the left hand with head of the cylinder away from you (Fig. 146) and insert tumblers, ribbed side toward you and long point down.

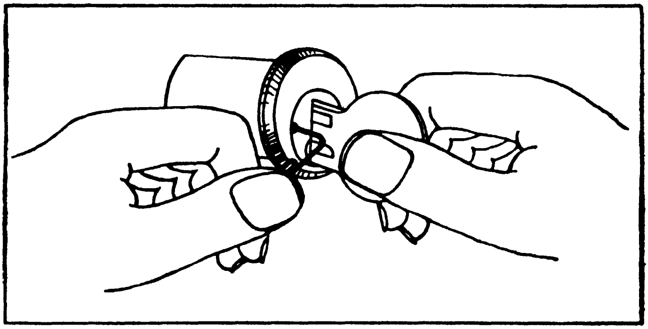


Fig. 145. This kind of lock cylinder is removed by turning key to the left, inserting small wire as shown, turning further to left and extracting cylinder with the key.

Second, start from the head and drop the indicated tumblers in their proper slots in the order called for by the code. After all are in place, check for correctness with the code (Fig. 147). Press tumblers down with finger (Fig. 148).

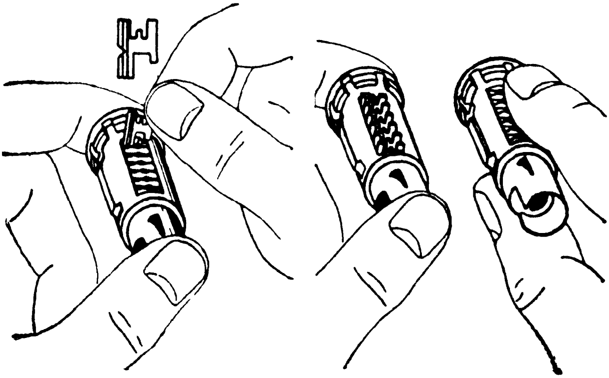
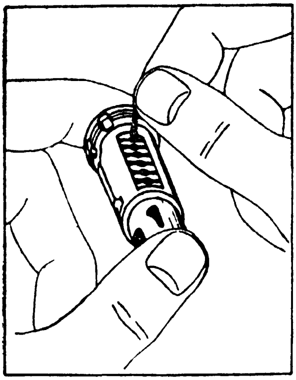


Fig. 146. Inserting tumblers.
Fig. 147. All tumblers in place.
Fig. 148. Tumblers pressed down with finger.

Third, insert one tumbler spring above each tumbler in round cavity (Fig. 149).

CAUTION: If springs are tangled do not pull tumbler springs apart—unscrew them.

Fourth, reverse cylinder in left hand so that head of cylinder is now toward you. Insert spring retainer (Fig. 150), so that its six sprongs each slip into one of the springs, and the two large end prongs slide into the slots at either end of the cylinder. Press retainer down with forefinger of left hand and in that position insert cylinder into checking and staking tool (Fig. 151). Still holding retainer in place with finger, pull lever on the tool over top of retainer to hold it in position (Fig. 152).



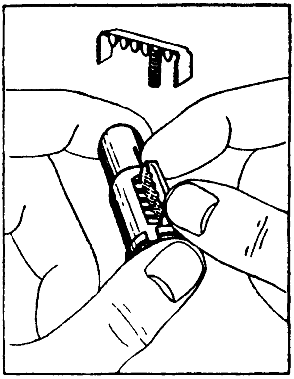
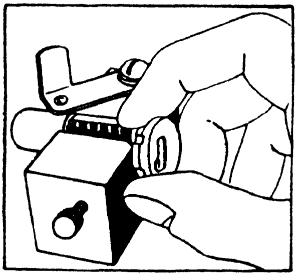


Fig. 149. Inserting tumbler springs.
Fig. 150. Installing spring retainer.



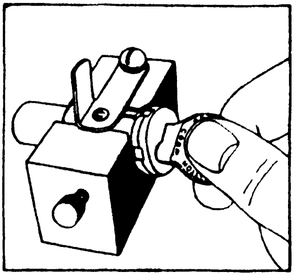


Fig. 151. Placing cylinder into checking and staking tool.
Fig. 152. Latching cylinder into checking and staking tool.

Fifth, to check: Insert the proper key and rotate cylinder clockwise about 1/8 turn. If lock is properly set up, cylinder will turn, otherwise the bar will not be released and cylinder cannot be rotated; in which case remove and reset tumblers properly.

Sixth, if cylinder rotates, return it to the original position and remove key (Fig. 153). Tighten set screw in left end of tool to prevent turning of cylinder.

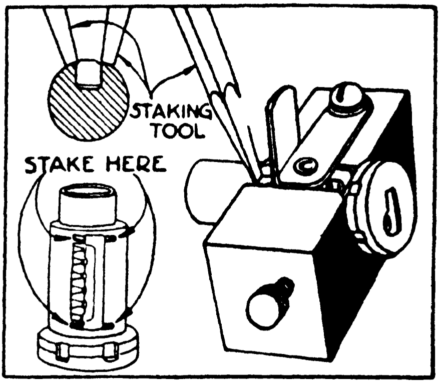


Fig. 153. Staking cylinder.

Seventh, stake down the retainer. The retainer is held in place by forming the cast metal over both edges of the retainer ends from the outside, using staking tool provided (Fig. 153). Hold staking tool at a right angle. Form the cast metal of the cylinder over the retainer with a single stroke of a light hammer for each of the four staking positions (Fig. 153).

Eighth, release set screw and remove cylinder.

Note.—If tumblers have been improperly assembled and not according to code, the tumblers can be removed from cylinder by holding cylinder with the tumbler slots down and pulling the bar out with fingers and jarring cylinder to shake the tumbler out. This procedure is necessary because after the tumblers have been pressed down into the cylinder as illustrated (Fig. 148), the tumblers are held in their slots by the bar.

Side Bar Key Cutting Machine

When cutting keys in the key cutter, the cutting positions are located by the spacer lever and the depths by the depth bar. To cut a key proceed as follows:

First, insert blank from right, with edge to be notched toward punch. Push blank all the way into stop. Tighten thumb screw to hold key blank in place (Fig. 154).

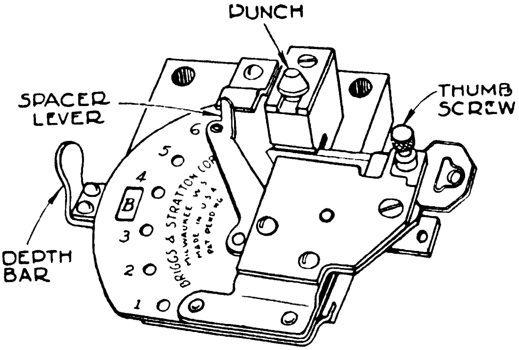


Fig. 154. Key cutter.

Pull spacer lever down to position 1 for first cut. Then adjust depth bar by compressing carriage with the thumb of right hand; in the direction indicated by arrows (Fig. 155), move depth bar with left hand until depth letter required appears in indicator window. Release carriage.

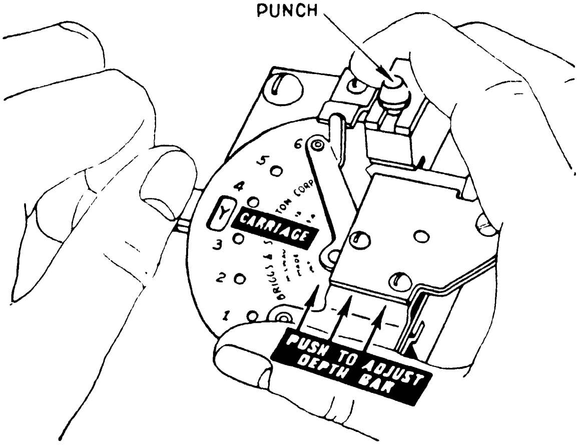


Fig. 155. Operating key cutter.

CAUTION: Be certain that the spacer lever is in correct indent and depth letter appears fully in the indicator window.

Second, to cut key, hit punch a quick, sharp blow with a light hammer.

Third, move spacer lever to position 2, compress carriage, and shift depth bar to letter required. Punch depth.

Fourth, continue as above, cutting required depths for positions 3-4-5-6.

Fifth, example:

Code Combinations
1-2-3-4-5-6
N-B-C*N-Y-B

Code No. 8021
How To Cut

Cutting Order	1-2-3-4-5-6
Set spacer lever to position	1-2-3-4-5-6
Move depth bar to letter	N-B-C*N-Y-B

*Depth "C" requires no cutting. See paragraph 1.

Check cut key with codes by inserting it into key decoder.

Note.—When there are two or more depths the same, after once setting the depth bar you can shift the spacer lever to any position calling for this depth, and make all these cuts without changing depth bar.

Using Key Decoder

First, hold key decoder in left hand, and insert key from the right.

Second, read code from head of key to tip, from positions 1 to 6. The depths cut are shown by the indicators under each position number (Fig. 156).

Third, an indicator reaching into the copper strip indicates depth "C." Indicator reaching into nickel strip indicates depth "N" in black strip "B" and in yellow strip "Y."

Fourth, the code of the key illustrated in the key decoder reads:

1-2-3-4-5-6
B-C-B-Y-N-Y

CAUTION: The tip of the indicator must split the colored strip.

Save the gauge key, furnished with each key decoder, to frequently check key decoder. Gauge key is cut Y-B-N-C-C-C.

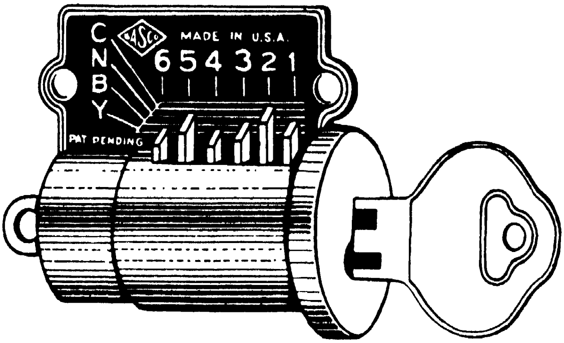


Fig. 156. Key decoder.

CHAPTER XVI

CLEANING UPHOLSTERY

Various types of upholstery present certain cleaning difficulties, but if the following instructions are followed, the results should be satisfactory.

Dust

Dust and dirt particles that fall on the surface of mohair sift down between the pile fibers, and are not ground into the material. They are easily removed with a whisk-broom, carpet beater, or vacuum cleaner. In so doing, dirt along the sides and rear of the seats falls to the bottom and can easily be wiped off. If beaten, the cushion should be held upside-down so that all the dust will fall away from it. Blows should be lightly administered. If a whisk-broom or vacuum cleaner is used, it is not absolutely necessary to remove the seats, but it is preferable.

Spots

Grease spots can be readily cleaned from mohair because they are broken up by the tips of the pile. In removing spots apply a small quantity of good cleaning fluid to a clean cloth, start well outside the area of the grease spot and work towards it. Repeat this several times, using a clean part of the cloth each time. This will remove the spot without leaving a circle of grease and dirt along the edge. Allow to dry thoroughly, then brush with whisk-broom. (See detailed instructions under "Specific Types of Stains.")

Washing with Soap and Water

Mohair can be washed safely with soap and water. Use luke-warm water and a neutral soap. The suds should be good and frothy, not watery. They should be applied in moderate quantities with a damp cloth, sponge, or soft brush. Rub with the pile, not against it. Soap suds should be removed with a clean, damp cloth or sponge. Then wipe the surface several times with a dry cloth. While the material is still damp, brush it lightly with a whisk-broom or brush of medium stiffness. Brush with the pile. Permit air to circulate freely over the wet upholstery. When dry, again brush with the pile.

Steaming the Pile

Sometimes, after long, hard use, the surface of mohair may become slightly flattened. In such cases it is easy to bring the pile back to its original position. Dry steam is ideal for this purpose. Simply steam the flattened spot liberally. If no dry steam is available, a damp cloth should be spread over the surface and a hot flat iron touched to it lightly. The steam that is thereby driven down into the fibers will restore them to the erect position. Another method is to take a cloth or a heavy towel, wrung out of very hot water and spread over the flattened spot. Leave the cloth in place for ten minutes or so. If the pile has been pressed down heavily, it may be necessary to repeat the process a few times. While still damp, the upholstery should be brushed lightly with a whisk-broom or brush of medium stiffness.

When thoroughly dry, the material should again be brushed. After this treatment the upholstery will look fresh and new.

General Instructions

1. Use clean cloths at all times and be sure a clean portion of the cloth is used throughout any operation.
2. A neutral (non-alkaline) hand soap similar to Lux, Ivory or Palmolive soap, is recommended in cases calling for soap or soap suds.
3. The use of hot water is to be avoided in removing stains, except where absolutely necessary. If it must be

used, extreme care should be exercised and it should be wiped off immediately, before it has a chance to run.

4. Do not use any gasoline as a cleaning solvent which is colored or contains tetra ethyl lead.

5. Carbon tetrachloride cleaning solvents and chloroform are non-inflammable. Most other types of cleaning solvents are inflammable and care must be exercised in handling them. Chloroform should be used carefully and in small quantities so that vapors are not inhaled.

6. Water spots may remain on the fabric if water has been used in the removal of the stain. These can be removed as outlined under "Water Spots."

7. All brushing of velvets should be in the direction of the pile, or lengthwise of the goods.

8. In removing grease spots start well outside the spot and rub toward it. This will lessen the possibility of causing cleaning rings.

Eliminating Rings after a Spot Cleaning Operation

There are numerous types of upholstering fabrics, and on some of these cleaning is more of a problem than on others. A flat cloth requires a different method of cleaning than mohair fabric, as mohair has a nap that allows the dust and soot to sink below the surface and not show on the surface so prominently. Flat fabric surfaces expose all soiled spots and therefore require cleaning more often.

Spot cleaning will leave rings of discoloration on flat fabrics more often than on nap fabrics and for that reason flat trim should be cleaned by taking the whole panel as a unit rather than a spot only.

After spot-cleaning on a cushion the spot when dry will invariably appear lighter than the surrounding cloth, which gives it the appearance of being faded. This usually denotes that the rest of the cushion was not perfectly clean before the spot-cleaning operation was started, and frequent attempts to remove or "blend in" this apparently faded section gives the trim a soiled or mottled appearance.

The following is a method of cleaning flat fabrics without leaving the usual discolored rings. This method has been used satisfactorily in Fisher Service and has proved superior to any other heretofore used, producing a neater and cleaner job.

Before spot cleaning, always thoroughly dust off the cushion, or better still, vacuum clean the surface, removing all accumulated dust and dirt.

Use carbon tetrachloride or any other equally good cleaning solvent, and with a clean white wiping cloth rub lightly over the soiled spot to remove all traces of the stain without rubbing it into the trim, changing to a clean part of the wiping cloth as often as it is soiled until no stain shows on the white wiper and the soiled spot has disappeared. Then clean the entire panel, using enough cleaner to saturate the whole panel, and while the surface is still wet use the suction nozzle of a vaccum cleaner to suck up through the fabric the surplus cleaning fluid which has dissolved the grime, leaving nothing to dry on the surface to discolor or ring it.

This applies to seat cushions and seat back cushions only. Do not use this method on mohair, or on door trim pads, arm rests, or headlinings as they may be ruined. Allow time for cushion to dry before using.

The kind of cleaning fluid to use on the above mentioned cushion trim is a matter of preference. Any good standard cleaner, provided it is non-explosive, is satisfactory. A mixture of carbon tetrachloride and naphtha is very good. This mixture is non-explosive and has thorough cleansing properties. In the cleaning process, clean hands as well as clean wiping cloths are essential. If possible the cushion should be removed from the car where free access may be had to all parts of the trim.

Cleaning Rubber Floor Mats Having Carpet Inserts

When cleaning this type of floor covering, use only castile soap and water, or an ammonia-soap cleaner which is whisked to a foam, and the foam used as the cleaner.

Hydrocarbon cleaners, such as naphtha, carbon tetrachloride, or other similar solvents, should never be used since they may dissolve the cement and separate the fabric from the rubber mat.

Specific Types of Stains

Battery Acids.—Pour enough ordinary household ammonia water directly on the spot so that it will be well covered. Permit the ammonia water to remain on the spot about a minute so that it will have ample time to neutralize the acid. Then rinse the spot by rubbing it with a clean cloth thoroughly wet with cold water.

This treatment will suffice for old and new stains; however, no type of treatment will repair damaged fibers which result from the action of the acids on the fibers, particularly after the spot has dried. It is therefore imperative that the spot be treated as quickly as possible. If so much as a day elapses between the time the acid was spilled on the cloth and the time of its treatment with ammonia, the acid in all probability will have produced a hole in the material.

Blood.—Rub the stain with a clean cloth wet with cold water until no more of the stain will come out. Care must be taken so that clean portions of cloth are being used for rubbing the stain.

The foregoing treatment should remove all of the stain. If not, then pour a little household ammonia water on the stain and after a lapse of about one minute continue to rub the stain with a clean, wet cloth. Nothing further can be done to remove the stain if this treatment has not been effective.

Hot water or soap and water must not be used on blood stains as their use will set the stain, thereby making its removal practically impossible.

Candy.—Candy stains other than chocolate can be removed by rubbing with a wet cloth with very hot water. If not then completely removed, sponging the stain (after drying) with a cloth wet with carbon tetrachloride will usually clean up the stain.

Candy stains resulting from cream and fruit-filled chocolates can be removed better by rubbing with a cloth soaked in luke-warm soap suds, together with scraping while wet with a dull knife. This treatment is subsequently followed with a rinsing by rubbing the spot with a cloth wet with cold water.

Stains resulting from chocolate or milk chocolate can be removed better by rubbing the stain with a cloth wet with luke-warm water. After the spot is dry it should be sponged with a cloth wet with carbon tetrachloride or chloroform.

Chewing Gum.—Moisten the gum with carbon tetrachloride and work the gum off the fabric with a dull knife while still moist.

Enamel, Paint, and Lacquers.—These materials are made by compounding two or more of the following types of materials: drying oils, driers, gums, resins, organic and inorganic pigments, nitrocellulose, organic solvents, and possibly a few other materials. It is, therefore, obvious that the quality, brand, and color of the paint, enamel, or lacquer are important factors governing the ease with which these materials may be removed from fabrics, as some pigments, gums, and oils are much more easily removed than others. The age of the stain is one of the most important factors to be considered. The older the stain, the harder it will be to remove; therefore, it is important that the stain be removed as quickly as possible.

An excellent method for removing stains of this type is as follows: If the stain is not dry, remove as much as possible by rubbing with a clean cloth wet with turpentine or the hereinafter-mentioned solvent mixture. This may be the only treatment necessary.

If the stain has dried and will not yield to the foregoing treatment, saturate with the following solvent mixture:

1 part denatured alcohol
1 part benzene
1 part acetone
1 part butyl or amyl acetate

Then work out as much of the paint as possible with a dull knife.

After repeating the foregoing treatment several times, saturate the stain with the paint remover solvent and immediately rub the spot vigorously with a clean cloth saturated with strong luke-warm soap suds. Then subsequently rinse by sponging with a clean cloth wet with cold water.

Fruits.—Fruit stains of practically all kinds can be removed by treatment with very hot water. Wet the stain well by pouring a little hot water (boiling if possible) directly on the spot. Scrape all excess pulp, if any, off the fabric with a dull knife. Then rub vigorously with cloth wet with very hot water. If this treatment does not suffice, sponging after drying with a clean cloth wet with carbon tetrachloride is the only further treatment recommended.

Soap and water is not recommended as it will more than likely set the stain and thereby cause a permanent discoloration of greater magnitude than the original stain. Drying the cloth by means of heat (such as by the use of an iron) is not recommended for the same reason.

Grease and Oil Stains.—If an excessive amount of grease has been spilled on the material, as much as possible should be removed by scraping with a dull knife or spatula before any further treatment is attempted.

Grease and oil stains may be removed by sponging and rubbing with a clean cloth wet with any one of several solvents, such as carbon tetrachloride, chloroform, benzene, ether, or motor gasoline (free from tetra-ethyl lead). In general, carbon tetrachloride is the best grease remover. To lessen the possibility of grease rings, start well outside the spot and rub toward it with a circular motion. Care should be taken to use a clean portion of cloth to rub the stain. Several cloths may be necessary.

To alleviate the possibility of ring formation and to confine the grease or oil to as small an area as possible, the following procedure may also be advantageous: Pour a small amount of the solvent directly on the spot and immediately press a white blotter very firmly on the spot. Repeat this procedure, using clean sections of blotting paper until the blotting paper no longer absorbs any grease.

If after repeated treatments with the solvent a dirty stain remains due to particles of dirt contained in the grease, the following treatment will probably be of advantage: rub the spot with luke-warm soap suds; rinse off the soap by sponging with a clean cloth wet with cold water.

Ice Cream.—The same procedure is recommended for the removal of the cream stains as that used in removing fruit stains.

If the stain is persistent, rubbing the spot with a cloth wet with warm soap suds may be used to some advantage after the initial treatment with hot water. This soap treatment will of course be followed by a rinsing by rubbing with a clean cloth wet with cold water.

After drying, a sponging with carbon tetrachloride will clear up the last traces of the stain by removing fatty or oily matter.

Ink (Writing Ink).—As the composition of various writing inks varies, it is therefore impossible to find agents which are equally effective in removing all ink spots. In general, no ink spot can be completely removed from velvets and flat fabrics without injuring the goods. The following methods are recommended and are listed according to their relative efficiency.

1. Commercial Ink Remover

    Gartside's Iron Rust Soap, manufactured by Gartside's Iron Rust Soap Co., Philadelphia, Pa., and on sale throughout the United States.

    Rub the soap into the stain with the fingers. Let stand about a minute and wipe off with dry cloth. Repeat the process till the wiping cloth no longer shows a stain. Then rinse by rubbing the spot with a cloth wet with cold water.

2. Saturate solution of oxalic acid.
3. 2 per cent solution of sodium acid fluoride (sodium bifluoride).

   Apply either of the above solutions to the spot with eye-dropper and then blot with blotting paper. Repeat the process until a clean portion of blotting paper shows no stain. Then rinse by rubbing with clean cloth wet with cold water.

Iron Rust.—Rub the spot with a clean cloth saturated with warm soap suds; rinse by rubbing with a cloth wet with cold water. After the fabric has dried, treat the remaining stain as if it were an ink spot. Any of the methods outlined for the removal of ink spots will clean up the stain perfectly.

Lipstick.—The compositions of various brands of lipsticks vary; therefore some lipstick stains may be removed more easily than others.

Pour a little chloroform or carbon tetrachloride on the stain and immediately press a blotter firmly on the spot. Repeat this procedure using new sections of blotting paper until the blotter no longer shows stain.

Liquor and Wine.—Treat liquor and wine stains in exactly the same manner as fruit stains.

Mildew.—Fresh mildew stains can be removed by rubbing vigorously with a cloth soaked in warm soap suds, followed with rinsing by rubbing with a cloth wet with cold water.

Old mildew growths can also be removed with the above soap and water treatment, but the discoloration caused by the growth probably cannot be removed. The only treatment recommended for removing discoloration caused by old mildew growths is an oxalic acid treatment as follows: Pour enough 10 per cent oxalic acid solution on the cloth to completely cover the stain. Allow to stand a minute and then remove the acid by alternate blotting with dry blotting paper and pouring cold or hot water on the stain.

Shoe Polish and Dressing.—Black and tan: rub the stain with a cloth wet with carbon tetrachloride until removed. Care must be taken so that a clean portion of the cloth is used for each rubbing operation.

White shoe dressing: allow the polish to become dry. Then brush the spot vigorously with a brush. This will probably be all the treatment that is necessary. If not, then moisten the spot with cold water and after it has again dried repeat the brushing operation.

This method applies particularly to types of white shoe dressing which contain only starch or dextrine or some water-soluble vehicle. In cases where water-insoluble vehicles are used in white shoe dressings, the methods of treatment will vary. Where the vehicle is wax, as in the case of black and tan polishes or dressings, the method described using carbon tetrachloride will usually suffice. In cases, however, where pyroxylin is used, it will be necessary to use acetone, ethyl, or butyl acetate or the mixture described for the removal of enamels, paints, and lacquers.

Tar.—Moisten the spot slightly with chloroform, carbon tetrachloride, benzene, or gasoline (not ethyl), and then remove as much of the tar as possible with a dull knife. Follow this operation by rubbing the spot with a cloth wet with any one of the aforementioned solvents until it is removed.

Water Spots.—Water spots can be removed as follows: Sponge the entire panel with a clean cloth wet with cold water. Sponge the spot with a rag wet with chloroform or carbon tetrachloride.

CHAPTER XVII

SERVICING FOLDING TOPS

The power-operated folding tops are both a challenge and an opportunity. When understood, there's money to be made in this kind of work.

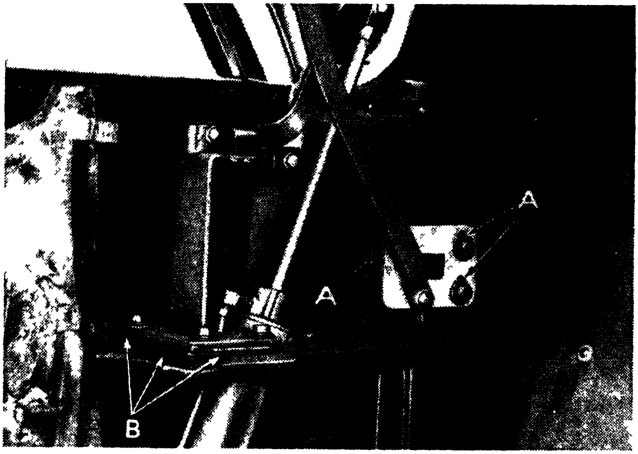


Fig. 157. Buick convertible top actuating cylinder, showing top alignment adjustments *A* and *B*.

One of the popular units for raising and lowering the tops is used on General Motors' cars, and since it combines hydraulic power electrically created, is known as the Hydro-lectric mechanism.

Total failure is usually due to lack of fluid or a blown fuse. The corrections are obvious.

Alignment and adjustment are essential to fully satisfactory operation. Fig. 157 shows one of the lifting cylinders. Removal or replacement for service is fairly simple. It does entail quite a bit of work, however, but total removal is rarely needed except in case of accident.

Mechanical adjustment of a convertible top requires good judgment on the part of the body man. The work and necessary steps to correct a certain top condition should be planned and figured out beforehand. Often a single adjustment will solve the problem. Again it may be necessary to combine two or three adjustments to get complete satisfaction.

Note in Fig. 157 the elongated bolt holes at A. For an up-and-down adjustment of the side roof rail, loosen the three bolts at *A*. Moving the adjusting plate down raises the side roof rail. Moving the plate upward lowers it.

The top can be shifted slightly fore and aft by shifting the plate forward or rearward, and tightening the bolts securely. Care should be exercised to avoid raising or lowering the plate when making this adjustment.

Oversize holes indicated by *B* at the base of the metal upright in Fig. 157 provide forward or backward adjustment for correct clearance at the rear quarter window. They also provide slight side-to-side adjustment of the top.

Whether servicing the top itself or operating it in connection with some other body work, it is important that it be handled properly.

In addition to avoiding damage that might possibly go unnoticed at the moment but cause embarrassment later, the correct handling of the top will build prestige in the eyes of the car owner.

Pictured is the approved step-by-step procedure:

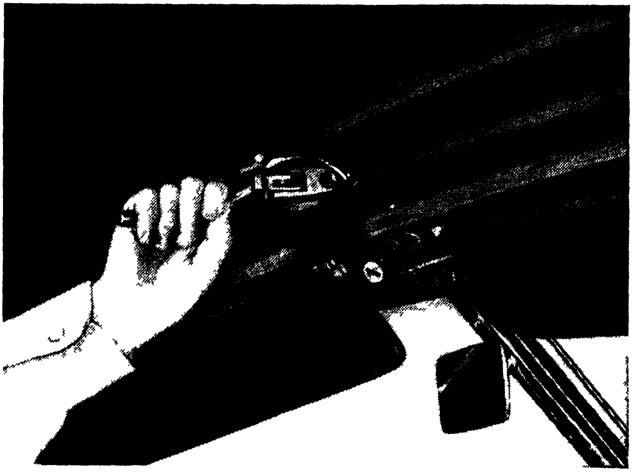


Fig. 158. Turn down sun visors and release the top center locking handle. Push the top of the front forward so that it clears the windshield header dowels.

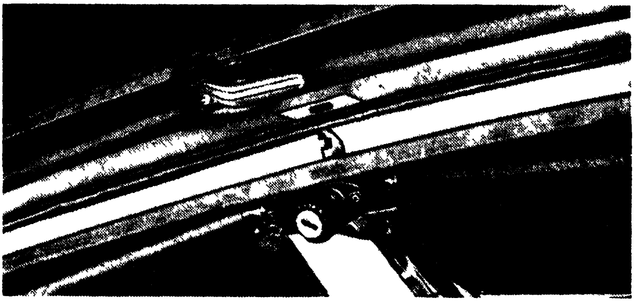


Fig. 159. After raising top above the windshield header dowels, return the locking handles to the locked position, as shown. Otherwise the extended handle may injure the fabric when the top is in a lowered position. This is important.

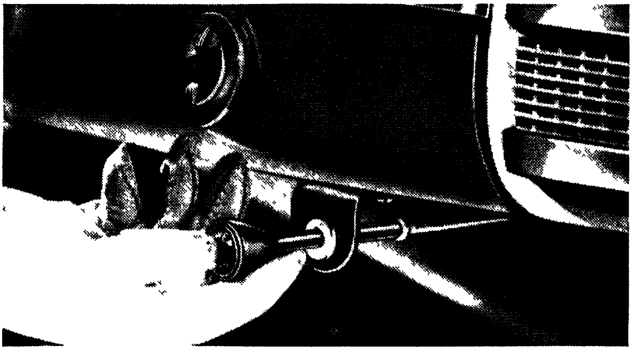


Fig. 160. Turn on the ignition switch and pull out the top control knob, and hold it out until the top is fully lowered. The top fasteners along the side roof rail and the chrome retainers at the rear quarter belt section are self-releasing. It is not necessary to lower the rear quarter window.

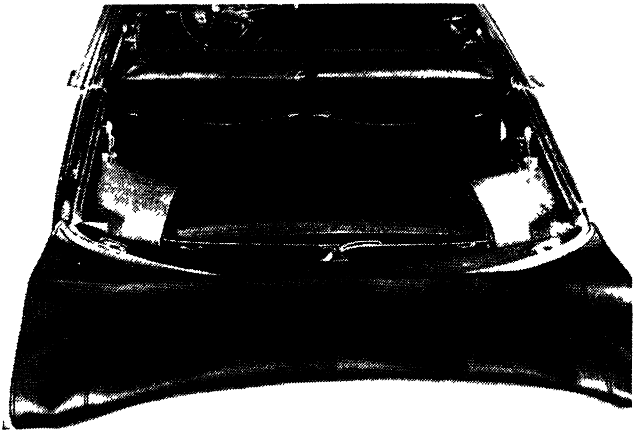


Fig. 161. After the top is lowered, raise it slightly by hand and pull the top material out from under the roof bows so that it is in the position on the rear body panel as shown in this illustration.

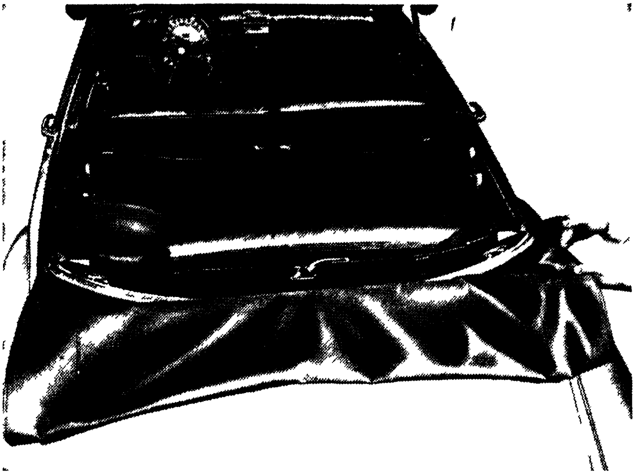


Fig. 162. On the right and left sides, pull out the top padding, as is being done here, and tuck it down into the top compartment. The top material and padding must not be pinched by the operating arms of the top.

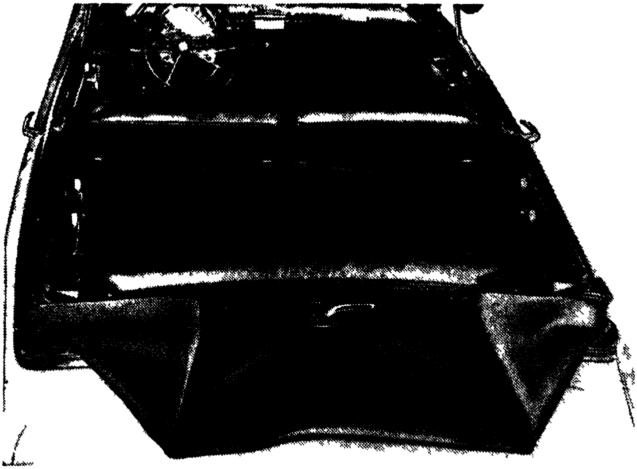


Fig. 163. Now fold over the corners of the top material like this.

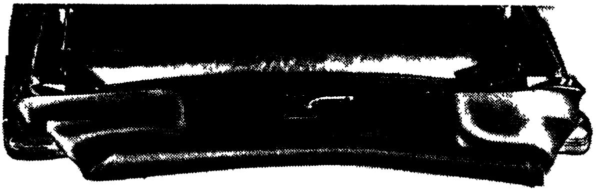


Fig. 164. Then roll up top material into a compact roll.

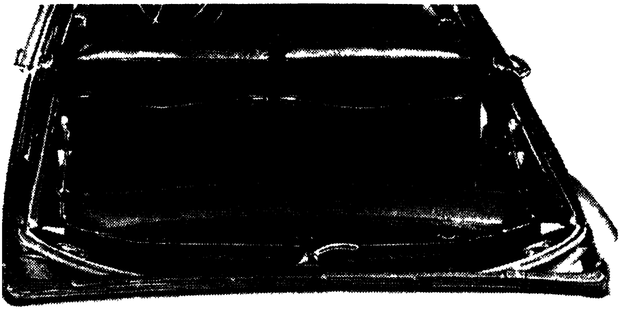


Fig. 165. Tuck this rolled-up top material down into the top compartment so that it looks like this.

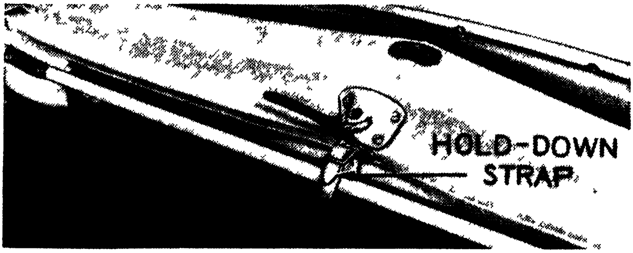


Fig. 166. Locate the leather "hold down" strap in the top boot kit, and slip the end of it through the metal loop located down in the top compartment and also at the center of the front roof rail. Then buckle it securely. This is important. Locking handle must also be in position as shown.

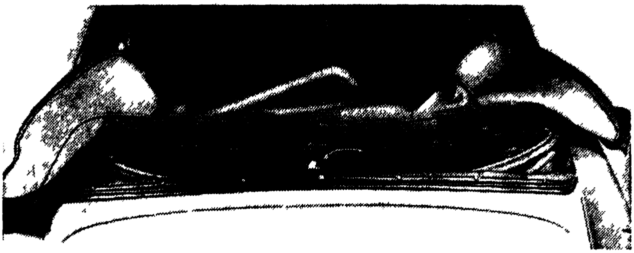


Fig. 167. To install the top boot, place it in position as shown in this illustration. The front skirt of the boot contains three metal supports which slip down into three metal loops located behind the seat back. After insertion of supports, fold the top boot back over the folded top, as in Fig. 168.

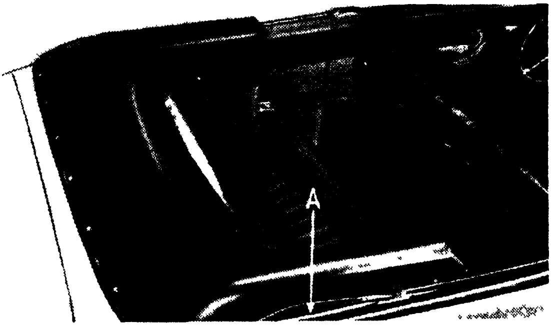


Fig. 168. In locations as indicated at *A*, tuck the boot side valance under the chrome trim retainers. Then at the rear belt and inside area of the boot, snap the fasteners into place. Failure to check to see that the top is securely strapped down prior to boot installation may cause serious damage.

The top should never be raised or lowered with the car in motion. And the top should never be stored unless it is thoroughly dry. Raising the top is done by removing the boot and unfastening the hold-down strap shown in Fig.

166, turning on the ignition, and pushing *in* on the top control knob illustrated in Fig. 160.

When the top is raised, pull out on the locking handle, Fig. 158, and draw the top down firmly over the windshield header dowels. Then turn the locking handle to the locked position.

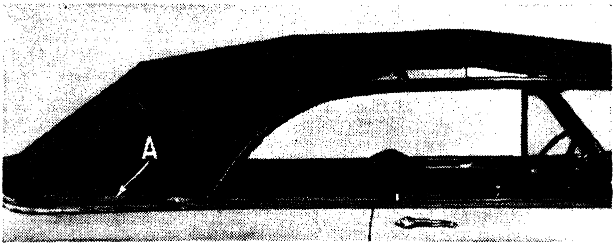


Fig. 169. With the top raised and fastened, tuck the edge of top side valance under the chrome trim retainer at the rear quarter belt section, as shown at *A*. Snap the fasteners in place along the side roof rail.

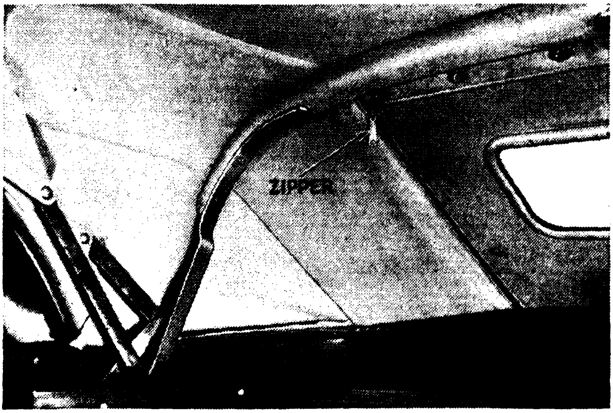


Fig. 170. To lower the rear curtain, slide the zipper fastener down to release the curtain at each side. In some cases it may be desirable to first relieve the tension on the top by releasing it at the front.

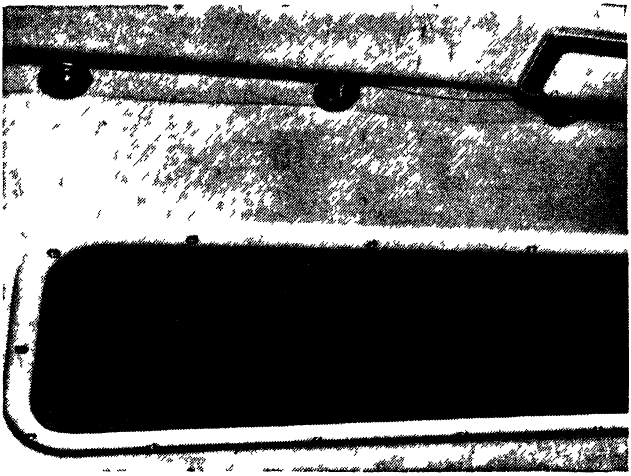


Fig. 171. Release the swivel fasteners at the top edge of the curtain on the inside of the car, as shown. Pull top edge of curtain downward to release curtain from clips at sides, and fold curtain toward inside of car.

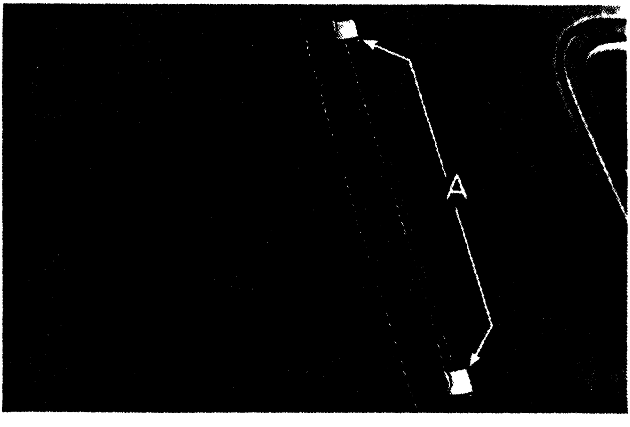


Fig. 172. To raise the rear curtain, reverse the procedue just given. On the outside of the car at both sides, engage the rear curtain clips to the curtain opening, as shown at *A*.

CHAPTER XVIII

SERVICING TRIM UNITS

Efficient handling of body work requires familiarity with interior trim. The speed and smoothness with which headliners, panels, seats, and other units can be removed and replaced has a big influence on shop profits.

It is obviously impossible to cover the construction of all cars so we have selected for discussion the interior trim of the Buick, which is considered a good example of sound engineering.

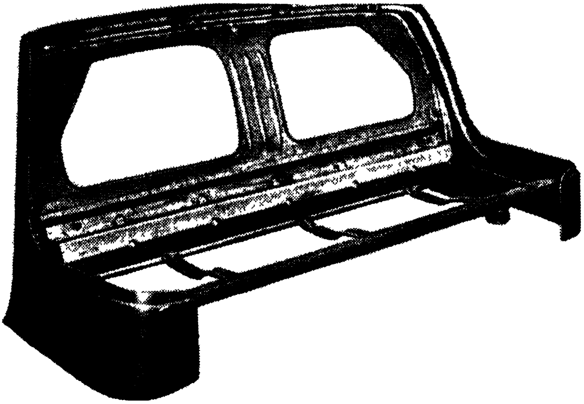


Fig. 173. Buick sedan metal front seat with stationary back.

In Fig. 173 is shown the sedan metal front seat with stationary seat back. Coupe construction is similar, except that the seat back is composed of two hinged sections.

In each construction, the seat cushion is held in position by extended seat side arms and a metal retainer at the front of the seat spring.

The top of the seat cushion assembly is held to the upper

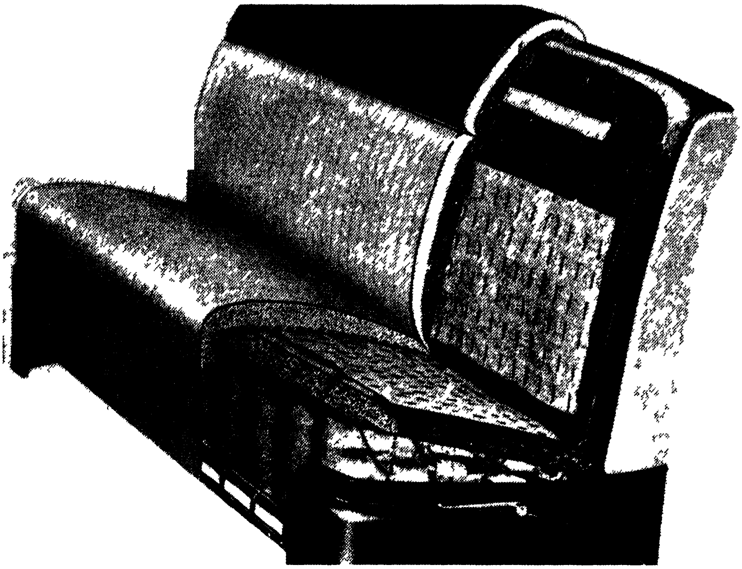


Fig. 174. Cut-away details of Buick front seat construction.

seat back panel with metal toggle fasteners. At the bottom it is held with metal bend-over clips.

Construction details are clearly shown in Fig. 174. Both cushion and back are of similar construction, being composed of cushion spring assembly, wire insulator, jute roll, cotton batts, rubber pad, cotton latexed pad, and the trim cover.

The difference in construction between back and seat is that in the back assembly the rows of helical springs have their bases set into "U" channels which anchor the springs and give rigidity to the assembly.

The complete seat assembly when trimmed is bolted, as indicated by arrows *A*, to a roller side channel seat adjuster, Fig. 175. This seat adjuster which is bolted to the steel floor is controlled by a seat adjuster handle located at the left side of the seat. On the Hydro-Lectric equipped convertible bodies, front seats are operated by push button control.

The headlining is the trim material that covers the entire roof interior section of the body (Fig. 176). Across the upper side of the headlining at spaced intervals, strips of muslin called "listings" are sewed. Through the hem of these "listings" during installation, insulated wires called "listing wires" are inserted for attachment of the headlining to the roof bows.

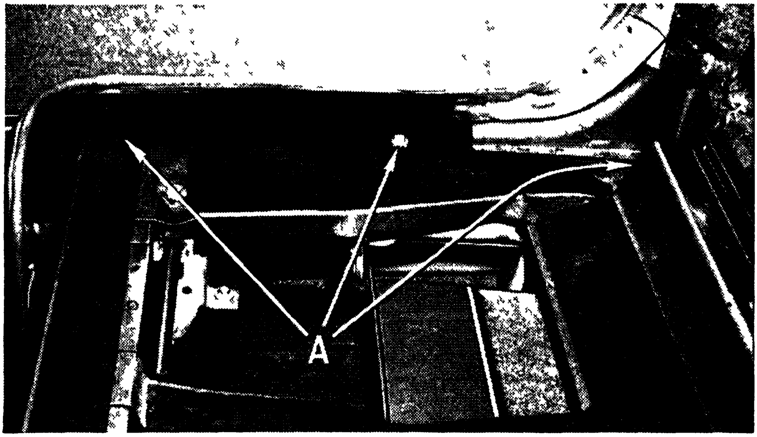


Fig. 175. *A* indicates bolts holding front seat to slide channel.

The side skirt of the headlining during installation is tucked under metal toothed retainers along the side roof rails.

The method of attaching the headlining to the roof bows is illustrated in the close-up cutaway, Fig. 177. Note the insulated wire running through the listing of the headlining and passing over one of a series of metal hooks or tabs which are spot welded to each roof bow. These hooks are then bent closed, thus forming the headlining to the curvature of the roof.

As has been mentioned, the headlining is secured to the side roof rails above the doors by metal retainers (Fig. 178) with lanced tabs. These are fastened with screws to

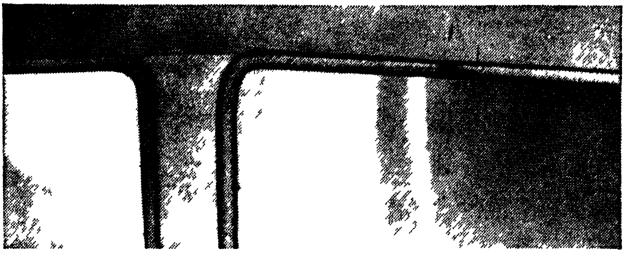


Fig 176 Headliner with windhose around door openings.

the side roof rails. During installation, the edges of the headlining are tucked under these toothed retainers by a dull wide-bladed tool similar to a glazing knife.

Fig. 178 shows the position of these retainers on a coupe which has retainers made in one piece and extending from the front body pillar to the rear body pillar. On sedans, three sections are used on each side. The front section extends from the windshield pillar to the center pillar. The center section butts against the front section, and extends part way around the radius of the rear door. The rear section butts against the center, and extends to the curvature of the rear body pillar. For proper snug retention of headlining, the retainer screws must be drawn up tight.

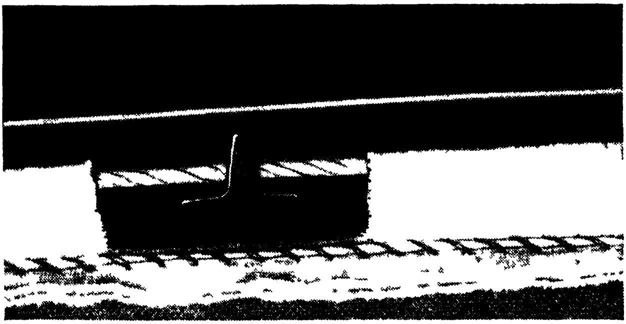


Fig. 177 Hook on top bow holding insulated wire of headliner listing.

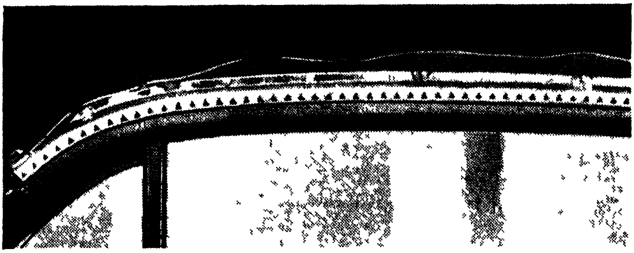


Fig. 178. Lanced metal strip above door holds headliner edge.

Numerous special fastenings are illustrated in Figs. 179 A, B, C, and D.

Fig. 179-A is a close-up sectional view of the headlining installation along the roof rail. The windhose or draft strip around the doors is first sewed to a waterproof cardboard foundation which is placed in position and held with retainer tabs, as shown at *A*. Over this the headlining retainer *B* is installed with screws.

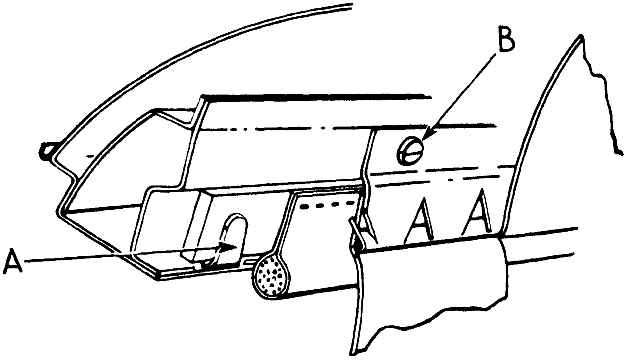


Fig. 179A. How windhose sewed to cardboard backing is held by metal tab *A* with headliner retainer held in place by screw *B*.

Fig. 179-B shows the attachment of the trim to the sedan center body pillar. The two strips of windhose, sewed to a die-cut cardboard foundation, are held with metal bend-over tabs, one of which is clearly visible. The center pillar trim panel has metal retainers with ratchet nails fastened

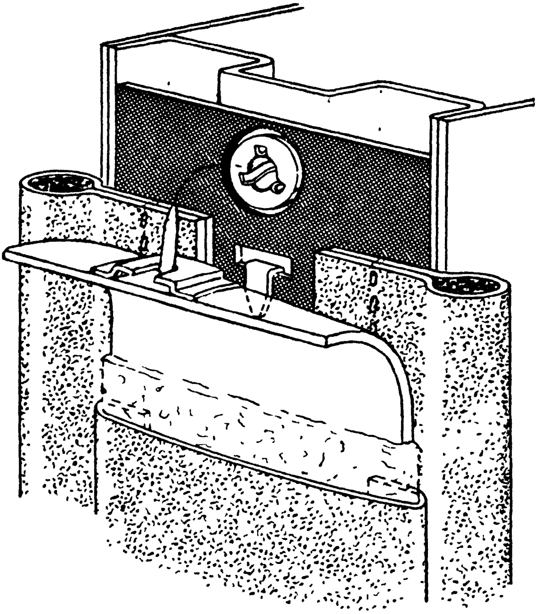


Fig. 179B. Details of construction and installation of sedan center body pillar trim.

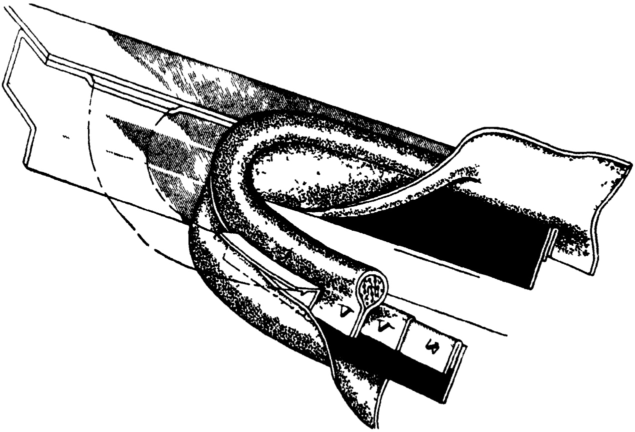


Fig. 179C. Details of construction and installation of windhose near windshield.

to its under side. The ratchet nails are driven into sockets provided in the center pillar. The trim is then drawn vertically tight and tacked at the top to a short trim stick.

Fig. 179-C shows how the windhose on the front body hinge pillar at the windshield area is installed by means of a combination metal retainer and cardboard foundation. This assembly, including the short metal retainer, is installed in the slots provided for it in the pillar.

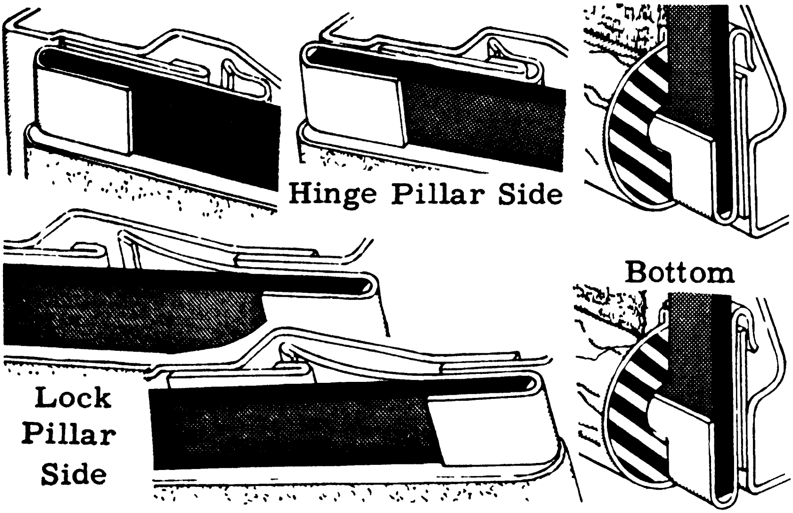


Fig. 179D. Methods of holding trim pad to door.

In 179-D we see the two methods of door trim pad installation that were used on some of the latest bodies. Some of the earlier bodies have trim pad retainers welded to the door inner panel at the sides and bottom. The trim pad foundation likewise has binding strips stapled to it at the sides and bottom. The pad slides into position with the retainers and strips having an interlocking action. The pad is anchored in position by a tapping screw at each lower corner. The drawings in Fig. 179-D show the interlocking arrangement of these trim pad retainers at the right and left edges of the door trim pad, and also at the bottom. On the newer bodies, the conventional method of nailing the trim pad with barbed nails through slots in the door inner panel is used.

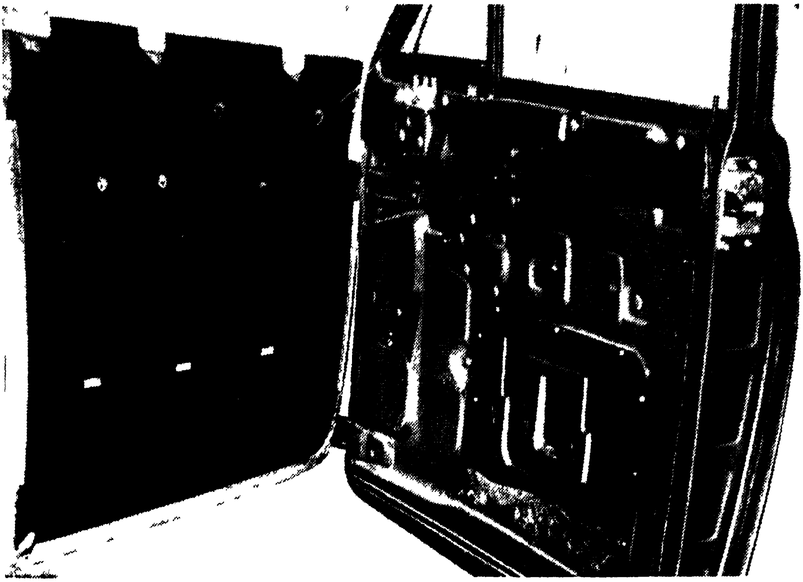


Fig. 180. Rear view of door trim pad.

The construction of a trim pad on its cardboard foundation is seen in Fig. 180. Note the holes in the cardboard foundation into which metal tabs along the door inner panel are inserted during installation. This construction was changed in late 1949, with the newer cars using nail-on type of trim pad installation.

CHAPTER XIX

FLOCK COATING

Flock coating of interior car surfaces is a new activity that is bringing profit to paint departments. A flocked surface has somewhat the appearance of suede, velvet, or plush, depending upon the method of application. The flock material is available in different colors including gold, light green, torquoise, beige, brown, gray, and others. It is made of wool, rayon, or cotton; and is cut to the length of one millimeter to obtain a velvet or plush effect, and to varied lengths to give a suede-like finish.

The fundamental of flocking can be likened roughly to throwing a handful of lint into a sheet of fly paper. The stuff would really stick. Of course that would be a silly thing to do, but it illustrates what the flock operation consists of.

First there's the application of the adhesive to the surface that is to be refinished. Then there is the application of the flock to the adhesive. In a matter of anywhere from 4 to 8 hours the adhesive has dried, and any loose flock can be blown off, leaving a surface that is extremely attractive and quite durable.

Naturally in the refinishing of automobiles there will be quite a number of owners who would appreciate a nice clean new-looking glove compartment, or who would like to have the shabby old trunk finished on the interior so that it would present a really attractive appearance.

One surprisingly attractive use of flock is on headliners that are soiled. If there are any holes in the headliner, repairs should be made first. Then the entire headliner should be sprayed with the adhesive, and the flock blown onto the adhesive.

Two types of guns are used for applying the coating of flock. An ordinary spray gun can be used for applying the adhesive. A special flock gun, however, must be used for applying the cut fibers. The manufacturers of spray painting equipment manufacture flock guns.

Some car owners may like to have flock applied to their door panels, but it is questionable whether this is a service which should be regularly sold. The appearance will be very attractive, but at the present time flock has not developed to the point where it is sufficiently durable to be recommended for surfaces where considerable wear or scuffing is likely to take place.

Different adhesives are produced for different types of surface. That is, a porous surface such as the fabric of a headliner will require one type of adhesive, while the adhesive that is sprayed onto the inner surface of a metal trunk lid will have different characteristics.

The adhesives, guns, and flock itself can be obtained through any large automotive jobber. In purchasing adhesive it is well to check on the rate of drying. Two qualities are important. First, it is essential that the adhesive dry slowly enough so that time will be available for applying the flock before the adhesive has started to set. Then when the flock has been applied to the adhesive, it is important that the adhesive harden in a reasonable length of time. Most adhesives at normal room temperatures will become too hard for the application of flock after about 12 minutes. These same adhesives will be thoroughly hard in anywhere from 4 to 8 hours so that the surplus flock can be blown or brushed away. Obviously any adhesive that begins to harden in less than 12 minutes would make it somewhat difficult to complete the job without having "bald spots" appear as a result of the fibers failing to adhere. On the other hand, if adhesive is used that is too slow in drying, a job can hardly be completed in a working day, and this, quite naturally, is a serious disadvantage.

All things considered, it is well to check over the available flocking supplies with any large automotive jobber and see what is necessary in order to get going on this relatively new and highly profitable refinishing service.

CHAPTER XX

LUBRICATION OF BODY HARDWARE

Since the lack of body lubrication or lubricating the body and body hardware incorrectly can cause considerable trouble, a few brief remarks will be made here on this subject. Too many owners feel that general car lubrication takes care of everything. It does not. In some instances it may, but very frequently some vital points are missed or the wrong lubricant is used.

Dripless Penetration Oil

This oil is thinned down with a solvent that easily penetrates tight places and cuts the grease or oil, thus allowing it to enter.

The solvent soon evaporates and leaves a film of heavy oil that will not run under ordinary heat and will not drip on other parts. This qualifies this oil for many uses around the body.

This lubrication should be used on the following parts and locations:

Door hinges
Door locks
Door check
Door window regulator bearings
Trunk hinges
Trunk lock
Trunk supports
Deck lid hinges
Deck lid lock
Deck lid support
Hood hinges
Hood catch bearings
Cowl ventilator

Door-Ease Grease Stick

Door-Ease Grease Stick is a heavy non-staining lubricant that leaves a film to lubricate but does not rub off or stain clothing. Only a small amount is needed which answers the purpose better than a large quantity.

This lubrication should be used on the following parts and locations:

Door lock striker plate
Door lock bolt
Door dovetail bumper wedgeplate
Trunk lock bolt
Deck lid lock bolt
Deck lid lock striker plate
Hood lacings
Hood catch

Graphite

Graphite in "microfyne" powdered form penetrates into crevices by blowing it in with the gun. Graphite lubricates where slow-moving flat surfaces occur and where oil or grease might collect dust and gum on the surface.

This lubrication should be used on the following parts and locations:

Door rubber bumpers
Door weatherstrips
Convertible coupe window glass runs
Door locking handle cylinders
All rubber weatherstrips

Soft Cup Grease

This lubrication should be used on the following parts and locations:

Windshield wiper housing cap
Door window cam channels
Adjustable front seat mechanism

Cleaning Lock Cylinders

Locking handle cylinders require cleaning and lubrication occasionally but they should never be oiled.

Oil will collect dust and grime that eventually will clog and render the locking mechanism inoperative.

To clean a lock cylinder, spray it inside with cleaning solvent to cut and dissolve the grease and oil. Work the key in it to see that it is in working order, then after the solvent has evaporated, spray with powdered graphite to lubricate. See chap. XV.

CHAPTER XXI

ESTIMATING THE COST OF REPAIR JOBS

Upon your ability to estimate the right cost for repair jobs rests your chances of making money in body and fender service.

If your price is too high you lose the job. If your price is too low you lose your profit. So there can be but one price —the right one.

But what is right? It is that price which pays for the parts and labor plus **overhead.** No one can tell you your cost of doing business but your own bookkeeper. And, unfortunately, no one can give you a prepared-in-advance set of figures that you can use for all kinds of wreck and repair jobs. You will have to watch your competitors and see what they get for certain jobs. If they can beat your price and still make money it may be due to better equipment or better procedure. Shop equipment, like automobiles, is undergoing constant improvement and if some of your equipment is many years old it may be holding you back.

A Price Guide

Not as a list of figures from which to quote but as a guide with which you can check your own figures to determine whether or not you are far out of line the following Plymouth time schedule is listed. It represents work actually done under normal service conditions with the kind of service equipment generally available in a modern service station. So if your time for any particular operation varies greatly from what is here shown look into your methods or your equipment. To arrive at the price you should charge multiply the hours required by the rate per hour for your shop.

Operation No.		Time
	BODY ASSEMBLY	
23-100	Body Bolts—Adjust and tighten	.8
23-105	Body Bolts—Replace (one)	.5
	For Each Additional Bolt (Add)	.3
23-110	Body Assembly—Remove and install	11.0
	BODY OUTSIDE FINISH MOULDINGS	
23-120	Center Pillar Belt Finish Moulding—Replace	.3
23-125	Rear Window Outside Finish Moulding—Replace	.4
23-126	Windshield Glass Outside Finish Moulding—Replace (one side)	.6
23-127	Windshield Glass Outside Finish Moulding—Replace (both sides)	1.0
23-128	Rear Quarter Belt Finish Moulding—(one)	1.0
23-129	Rear Quarter Belt Finish Moulding—(two)	2.0
23-130	Body Side Sill Moulding—Replace (one side)	.6
23-131	Front Door Belt Finish Moulding—Replace (one)	.3
23-132	Rear Door Belt Finish Moulding—Replace (one)	.3
	BODY PANEL TRIM—HEADLINING	
23-135	Center Pillar Trim Panel—Replace (one)	.3
23-136	Cowl Quarter Trim Panel—Replace (one)	.3
23-137	Rear Shelf Trim Panel—Replace	.4
23-138	Rear Quarter Trim Panel—Replace	.3
23-140	Headlining—Replace Sedan or Coupe	4.0
	COWL VENTILATOR	
23-150	Cowl Ventilator—Adjust	.2
23-155	Cowl Ventilator Lid—Replace	.4
23-160	Cowl Ventilator Screen—Replace	.8
23-165	Cowl Ventilator Lid Weatherstrip—Replace	.5
	DOOR ASSEMBLY	
23-170	Door Assembly—Align (estimate)	...
23-175	Door Assembly (Front)—Replace	2.8
	INCLUDES: Transferring trim, glass and hardware.	
23-180	Door Assembly (Rear)—Replace	2.8
	INCLUDES: Transferring trim, glass and hardware.	
23-185	Door Assembly—Remove and install	.8
23-190	Door Trim Panel (Front or Rear Door)—Replace	.4
	DOOR HANDLES—REMOTE CONTROL—LOCKS	
23-200	Door Handle (Inside or Outside)—Replace	.3
23-205	Door Lock (Latch) Remote Control—Replace	1.1
23-210	Door Lock Cylinder—Replace	.4
	DOOR HINGES—CHECKS—DOVETAILS—STRIKERS	
23-230	Door Hinge Assembly (Front Door)—Replace (one) (upper)	1.2
23-235	Door Hinge Assembly (Rear Door)—Replace (one)	1.0
23-240	Door Check (Front Door)—Replace	.4
23-245	Door Check (Rear Door)—Replace	.5
23-250	Door Dovetail—Replace (one)	.3
23-255	Door Striker Plate—Replace (one)	.3

DOOR WEATHERSTRIPS—WEATHER CORDS

Operation No.		Time
23-270	Door Flange Weatherstrip—Replace (one door)	.6
23-275	Door Lower Weatherstrip—Replace (one door)	.3
23-280	Door Weather Cord—Replace (front door)	1.2
23-285	Door Weather Cord—Replace (rear door)	.9

FLOOR BOARD AND MAT—CARPETS

23-300	Floor Board—Replace	1.2
23-305	Front Floor Mat—Replace	.4
23-310	Door Sill Mat—Replace	.3
23-315	Luggage Compartment Floor Mat or Carpet—Replace	...
23-320	Rear Floor Mat Assembly—Replace	.5
23-325	Foot Rest Mat—Replace	.4

GLOVE BOX

23-340	Glove Box Door—Align	.2
23-345	Glove Box Door Lock Catch—Replace	.3
23-350	Glove Box Door Hinge—Replace	.3
23-355	Glove Box Door Latch (Lock Type)—Replace	.3
23-360	Glove Box Assembly—Replace	.3

INSTRUMENT PANEL—ASH RECEIVERS

23-370	Instrument Panel—Replace INCLUDES: Drop heater control panel and remove radio. Remove windshield moulding, steering column bracket and drop hood release lever. Disconnect cowl ventilator bracket, disconnect wires wires and remove instrument panel. Disassemble instrument panel complete and assemble to new instrument panel. Install instrument panel in car.	4.0
23-380	Instrument Panel Center Grille (without radio)—Replace	.6
23-385	Instrument Panel Center Grille (with radio)—Replace	1.0
23-395	Instrument Panel Ash Receiver Lid—Replace	.2

LUGGAGE COMPARTMENT

23-400	Luggage Compartment Lid—Align (estimate)	...
23-405	Luggage Compartment Lid—Replace	1.3
23-410	Luggage Compartment Front Lining Panel—Replace	.4
23-415	Luggage Compartment Lid Name Plate—Replace	.3
23-420	Luggage Compartment Lid Weatherstrip—Replace	.4

LUGGAGE COMPARTMENT LID HANDLE STRIKER PLATE—LOCK—HINGES

23-430	Luggage Compartment Lid Handle—Replace	.5
23-435	Luggage Compartment Lid Lock Catch—Replace	.3
23-440	Luggage Compartment Lid Lock—Replace	.3
23-445	Luggage Compartment Lid Hinge—Replace (one)	.5
23-450	Luggage Compartment Lid Hinge—Replace (two)	1.0
23-455	Luggage Compartment Lid Hinge—Replace (one)	.3
23-460	Luggage Compartment Lid Hinge—Replace (two)	.6
23-465	Luggage Compartment Lid Prop—Replace	.3

SEATS—SEAT TRIM—ARM RESTS

Operation No.		Time
23-480	Front Seat Guide Assembly—Replace (both sides)	1.0
23-485	Front Seat Guide Assembly Handle—Replace	.3
23-490	Front Seat Guide Assembly Lock Spring—Replace	.3
23-495	Front Seat Guide Assembly Tension Spring—Replace	.3
23-500	Front Seat Assembly—Replace Does not include replacing trim.	.8
23-505	Seat Cushion Trim (Front or Rear)—Replace (one)	1.4
23-510	Front Seat Back Trim—Replace	1.0
23-515	Back of Front Seat Back Trim—Replace	2.5
23-520	Rear Seat Back Trim—Replace	1.6
23-525	Arm Rest—Replace (one)	.2

TOP—CONVERTIBLE COUPE

23-550	Top Assembly Operating Mechanism—Free up and adjust	1.0
23-555	Top Assembly—Remove and install	4.1
23-560	Operating Switch—Replace	.5
23-565	Folding Top Operating Cylinder—Replace (one)	1.0
23-570	Folding Top Operating Cylinder—Replace (two)	1.6
23-575	Top Material—Replace	10.0
23-580	Folding Top Lift Wiring Harness—Replace	2.6
23-585	Folding Top Motor, Pump and Reservoir Assembly—Replace	.5

WINDSHIELD AND DOOR GLASS

23-600	Windshield Glass—Replace (two)	2.0
23-605	Windshield Glass—Replace (one)	1.5
23-610	Front Door Glass—Replace (one door)	1.0
23-615	Front Door Vent Wing Glass—Replace (one)	1.0
23-620	Rear Door Glass—Replace (one door)	1.0
23-625	Rear Door Vent Wing Glass—Replace (one)	.8
26-630	Rear Window Glass—Replace	1.1
23-635	Door Glass (Convertible Coupe)—Replace	1.4
23-640	Vent Wing Glass (Convertible Coupe)—Replace	1.6
23-645	Quarter Window Glass (Convertible Coupe)—Replace	1.4

WINDOW GLASS CHANNELS—RUNS—WEATHERSTRIP

23-660	Front Door Glass Lower Channel—Replace	1.0
23-665	Rear Door Glass Lower Channel—Replace	1.0
23-670	Quarter Window Glass Lower Channel—Replace	1.4
23-675	Front Door Glass Run Rear Channel—Replace	1.2
23-680	Rear Door Glass Run Front Channel—Replace	1.2
23-685	Front Door Glass Run—Replace	1.0
23-690	Rear Door Glass Run—Replace	1.0
23-695	Front Door Glass Division Channel Run—Replace	1.3
23-700	Rear Door Glass Division Channel Run—Replace	1.3
23-705	Door Glass Dust Weatherstrip—Replace	.8
23-710	Door Glass Division Bar and Vent Window Frame—Replace	1.4

WINDSHIELD AND DOOR GARNISH MOULDING

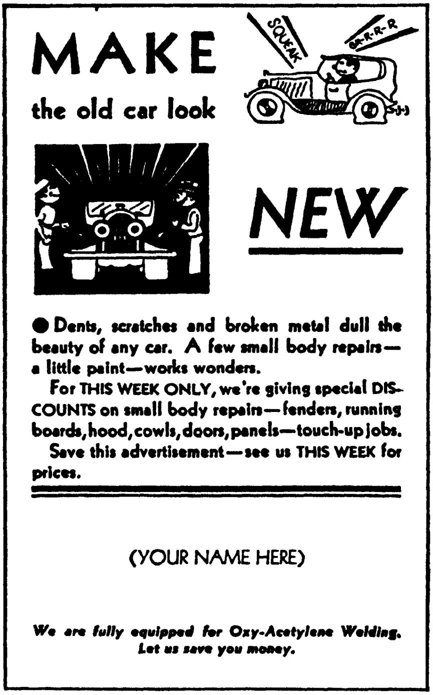
23-750	Door Garnish Moulding (Front or Rear Door)—Replace	.3
23-755	Rear Window Garnish Moulding—Replace	.3
23-760	Windshield Garnish Moulding—Replace	.6

CHAPTER XXII

WAYS OF INCREASING SHOP PROFIT

To help the shop owner sell repair service—to get his sales message to logical prospects as quickly and inexpensively as possible—a number of business-getting suggestions are here discussed. They have all proved effective.

To make the advertising job still easier, the electrotypes for post card, handbill and newspaper advertisements, and the pamphlets and lantern slides illustrated on these pages have been prepared and are available from the Linde Air



MAKE
the old car look

NEW

● **Dents, scratches and broken metal dull the beauty of any car. A few small body repairs—a little paint—works wonders.**

For THIS WEEK ONLY, we're giving special DISCOUNTS on small body repairs—fenders, running boards, hood, cowls, doors, panels—touch-up jobs.

Save this advertisement—see us THIS WEEK for prices.

(YOUR NAME HERE)

We are fully equipped for Oxy-Acetylene Welding. Let us save you money.

Fig. 189. Ad for Appearance Conditioning.
No. 100—Electrotype for post card or handbill
No. 101—Mat for newspaper advertising
No. 102—Lantern slide for motion picture theater

Products Co. to progressive shop owners. Those who take advantage of the availability of this material, and who adapt it to their own needs by following the suggested selling methods, will obtain a very gratifying increase in business.

Each of the methods described has been tested in general use and proved very effective when properly adapted to meet individual conditions. A little study on the part of the shop owner will indicate the best program to follow. Naturally such a sales promotion plan involves a certain expenditure of time and money, but the increased profits will more than pay for the initial outlay.

Post Card Mailings

One of the best ways of telling prospects what you can do for them is through the use of post cards. Select the electrotypes desired from those illustrated on these pages and have them printed on penny post cards. Obtain a good list of nearby automobile owners and mail the cards at intervals sufficient to maintain work in the shop at a steady level. The total cost for the cards and for having them printed is about $17.00 per mailing per thousand.

Handbills

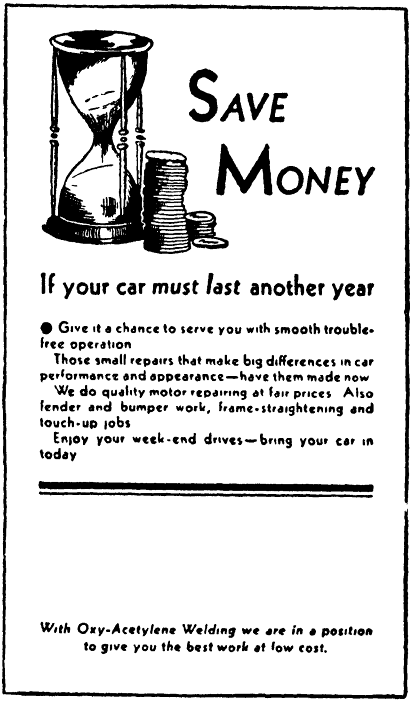
Handbills, which may also be prepared from these same electrotypes, are another excellent means of getting your story to the car owner. To distribute these, some shops print up shipping tags which can be hung on the steering wheel of parked cars, while still others use printed cardboard stock which is cut out so as to slip over door handles.

Newspaper Advertisements

The advertisements illustrated on these pages also are available as mats for newspaper use. A newspaper campaign in conjunction with direct mail promotional efforts or handbill distribution has proved an effective combination for building business. Where only one of the methods can be used local conditions will determine which will bring the best results.

Slides for Motion Picture Houses

Lantern slides are available for each of the advertisements for use in motion picture theaters which carry advertising of this type. These slides are made up with the advertiser's name and address and are an excellent means for bringing the shop owner's business to the attention of theater-goers.



If your car *must last* another year

● Give it a chance to serve you with smooth trouble-free operation

Those small repairs that make big differences in car performance and appearance—have them made now

We do quality motor repairing at fair prices Also fender and bumper work, frame-straightening and touch-up jobs

Enjoy your week-end drives—bring your car in today

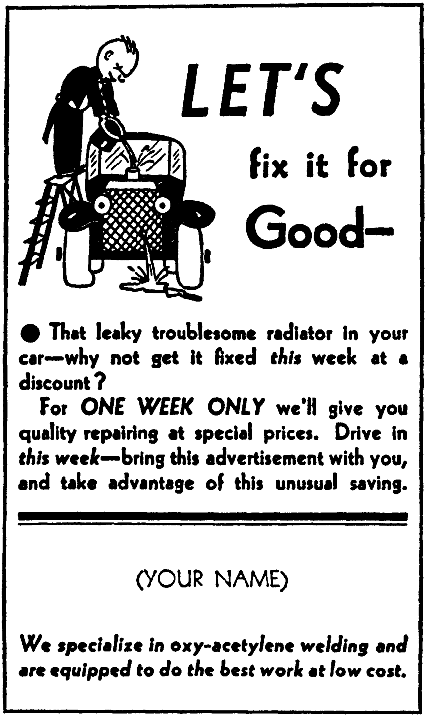
With Oxy-Acetylene Welding we are in a position to give you the best work at low cost.

Fig. 190. An Appeal to Economy.
No. 200—Electrotype for post card or handbill
No. 201—Mat for newspaper advertising
No. 202—Lantern slide for motion picture theater

Letterhead Illustrations and Signs

Fig. 194 illustrates an electrotype which is available for imprinting letterheads, billheads, and other forms which the shop may have occasion to distribute. Such an illustration, either above or below the name and address on your shop stationery, is another way of letting your customers and prospects know you are equipped to furnish them a valuable service.

This same illustration can readily be copied in an enlarged form by a capable painter and used on shop doors or windows, or on the doors of service cars.



LET'S

fix it for

Good—

● That leaky troublesome radiator in your car—why not get it fixed *this* week at a discount?

For *ONE WEEK ONLY* we'll give you quality repairing at special prices. Drive in *this week*—bring this advertisement with you, and take advantage of this unusual saving.

(YOUR NAME)

We specialize in oxy-acetylene welding and are equipped to do the best work at low cost.

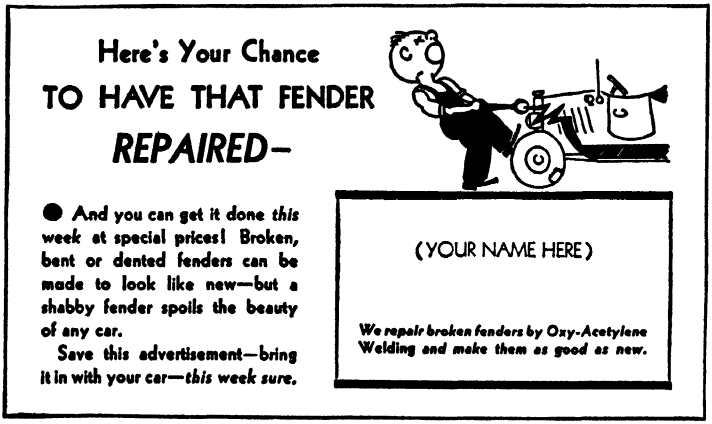
Fig. 191. Humor That Attracts Trade.
No. 300—Electrotype for post card or handbill
No. 301—Mat for newspaper advertising
No. 302—Lantern slide for motion picture theater

Radio Broadcasting

If local radio broadcasting facilities are available, it will pay to check up on the arrangements that can be made for inexpensive advertising through this medium. Broadcasting announcements of weekly repair specials, similar to those in the advertisements illustrated, is a good tie up.

Telephone Calls

Telephoning involves little expenditure of money and can be used most effectively in contacting small manufacturers, tradesmen, building owners, and auto repair prospects. If used regularly, it will help build profitable volume.



Here's Your Chance
TO HAVE THAT FENDER
REPAIRED-

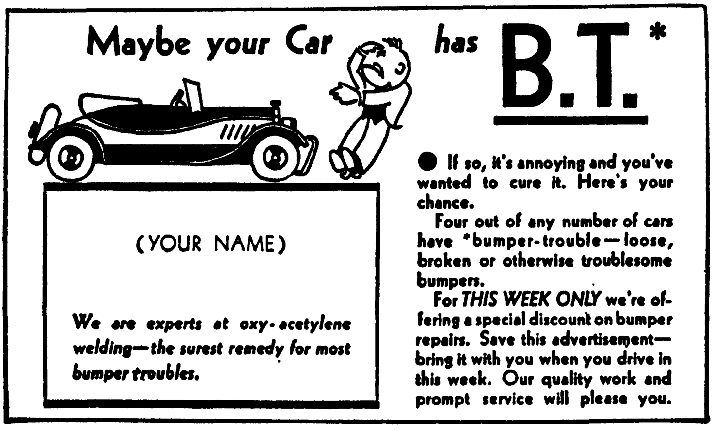
● And you can get it done *this week* at special prices! Broken, bent or dented fenders can be made to look like new—but a shabby fender spoils the beauty of any car.

Save this advertisement—bring it in with your car—*this week sure.*

(YOUR NAME HERE)

We repair broken fenders by Oxy-Acetylene Welding and make them as good as new.

Fig. 192. Ad Featuring Fender Service.
No. 400—Electrotype for post card or handbill
No. 401—Mat for newspaper advertising
No. 402—Lantern slide for motion picture theater



Maybe *your Car* *has* B.T.*

● If so, it's annoying and you've wanted to cure it. Here's your chance.

Four out of any number of cars have *bumper-trouble — loose, broken or otherwise troublesome bumpers.

For *THIS WEEK ONLY* we're offering a special discount on bumper repairs. Save this advertisement—bring it with you when you drive in this week. Our quality work and prompt service will please you.

(YOUR NAME)

We are experts at oxy-acetylene welding—the surest remedy for most bumper troubles.

Fig. 193. Curiosity Gets This Ad Read.
No. 500—Electrotype for post card or handbill
No. 501—Mat for newspaper advertising
No. 502—Lantern slide for motion picture theater

Personal Selling

Finally, personal selling by the shop owner and his employees is one of the surest ways for keeping old customers and getting new business. The manner of dealing with customers, the quality of the work, the appearance of the shop, and the business methods of the shop all make a strong impression on the customer. A customer who is satisfied with the workmanship and business methods of the shop is not only a permanent customer, but he also tells others about your service.

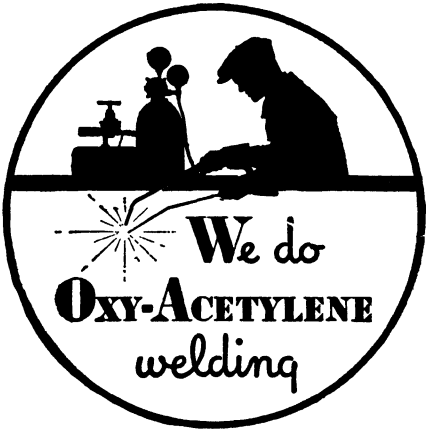


Fig. 194. This electrotype is available for imprinting letterheads, billheads and other shop forms. It is No. 800.

How To Obtain This Advertising Material

The electrotypes for post card and handbill advertisements; the mats for newspaper advertisement; the slides for motion picture houses; the pamphlets for distribution to home owners and farmers; and the electrotype for imprinting shop stationery can be secured by users of Linde products by writing to the nearest office of the Linde Air Products Company. Use the illustrations in this book as a catalogue and indicate the material desired by noting the illustration numbers **in your letter (not the book figure numbers).**

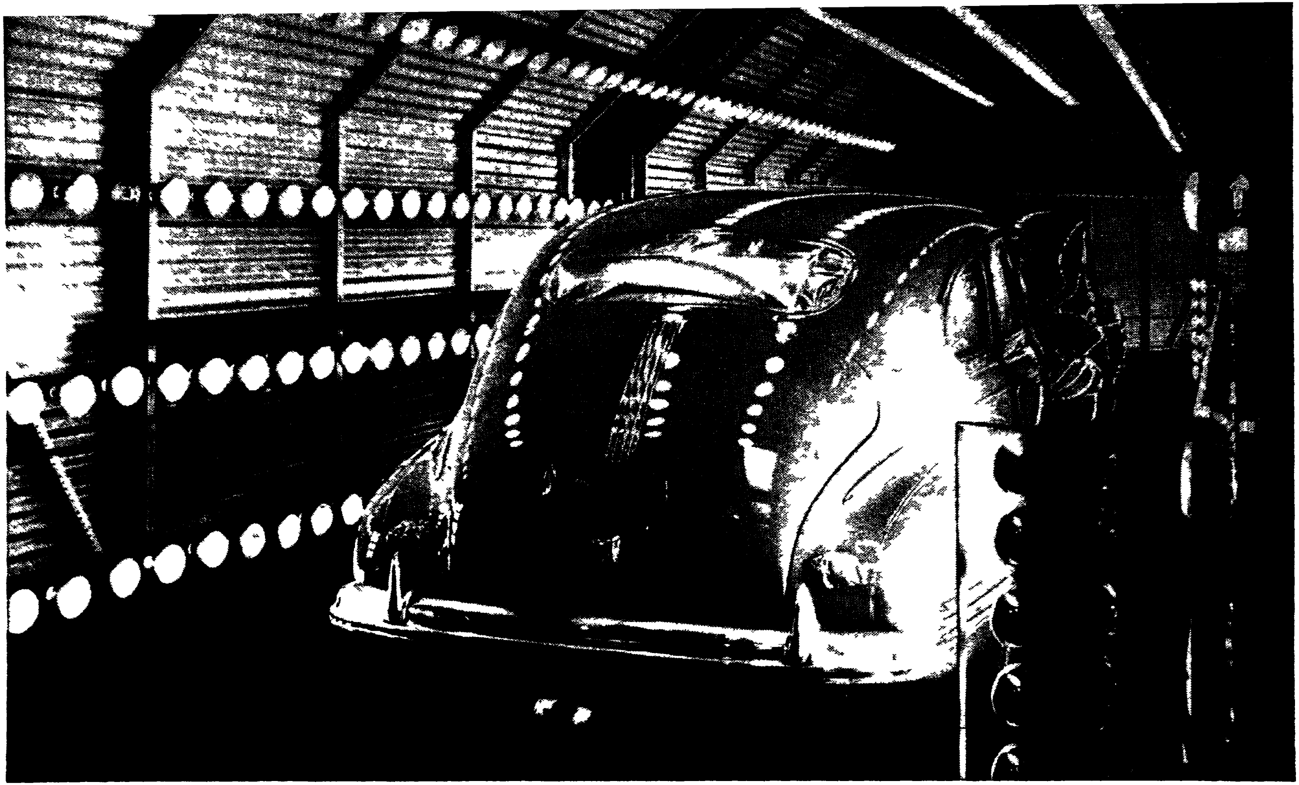


Fig 194A A portion of an infra-red drying booth showing both stationary and portable lamp installations
(Courtesy of Automotive Digest)

CHAPTER XXIII

INFRA-RED PAINT DRYING

Better paint jobs, and more of them, can be turned out by a shop that has control over the drying process. The application of heat and ventilation described elsewhere in this book is one method. The use of infra-red electric lamps is another method, and one which is applicable to the small repair job or the complete refinishing of a car.

In the illustration of a large infra-red paint drier (Fig. 194A), it is interesting to note the small portable drier in the lower right corner. This is used for drying a fender, door, or other small part after refinishing. The entire oven allows complete cars to pass through, and, in fact, two cars can be accommodated in this large drier at one time, as shown. The installation pictured is that of the Durable Auto Painting Company of Los Angeles. The oven is equipped with 528 individual lamps. It might be interesting to note that the company does nothing but automotive refinishing, but does it in a big way.

An idea of how profitable automotive refinishing can be may be obtained from the fact that this organization now occupies 25,000 square feet of shop space and employs 100 skilled workers. The incoming cars are completely cleaned and hand sanded, then masked. Synthetic enamels are applied in glass-enclosed filter-air spray booths, and the car then goes to the baking tunnel which is seen here.

Speeding up the drying process, understandably, enables a shop to turn out more jobs per day. The quality arises from the fact that since there is less time required for drying, there is less opportunity for dirt and dust to get into the finish. Furthermore, the speedier drying reduces the likelihood of sags developing.

It is pretty generally agreed that a temperature of 150°F. is the maximum that a car can stand safely. Anything more than this is likely to cause damage to the safety glass, the battery sealing compound, or the glue in the upholstery panels. Even at this temperature the drying period should not exceed an hour. And there are many who prefer 125°F. for 1½ hours.

When using heated air for drying panels, it is important to maintain air circulation. Failure to do this will prevent proper oxidation of the finish. Air filters are a "must." They can be made of frames carrying oiled steel wool, or they may be of the commercial variety.

Since this matter of drying automobiles is a constantly developing one, the alert shop operator will watch the advertising in the leading automotive publications. One interesting drier now on the market consists of an arch of infra-red lamps that goes over the car. The car can be sprayed in almost any part of the shop. Then this heating arch is placed over the car, and by means of an electric motor in its base, it moves back and forth over the car to dry the surface quickly and uniformily. Such equipment may often be obtained directly from the manufacturer whose advertising appears in automotive publications, or may be purchased through the larger automotive jobbers.

CHAPTER XXIV

EQUIPMENT FOR REFINISHING

You can get into the refinishing business for almost any amount of money that you want to spend. But the profit that you make will be directly influenced by your investment. This doesn't mean that limited equipment can't do a quality job. It can. But the extra time required to do the job will probably eat up the profits.

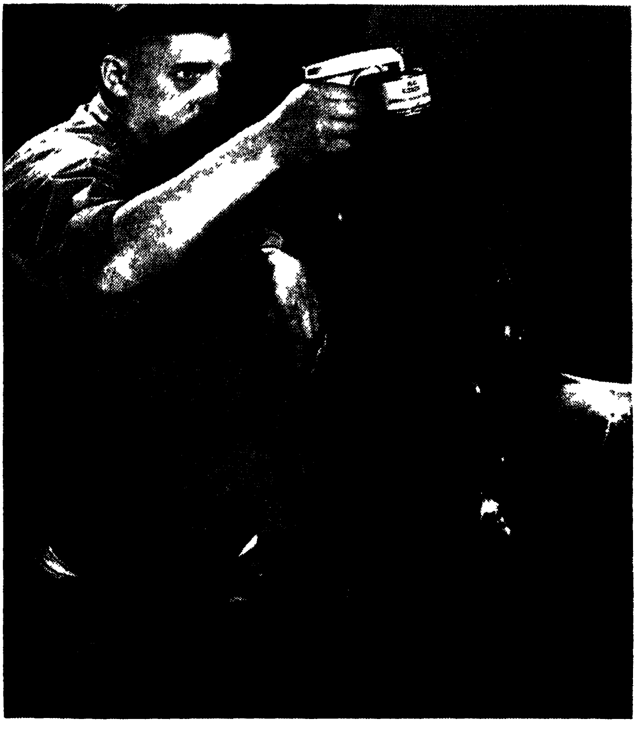


Fig. 195. Spray gun for touch-up jobs operated with air from tire.

An item of interest in any shop that has an occasional spot to touch up or scratch to cover is a spray gun as shown in Fig. 195, which is operated with air from a tire. While this item is used and sold by Ford dealers, its limitation is obvious.

To help paint-shop operators and prospective shop owners picture the basic equipment needed for refinishing, The DeVilbiss Company has compiled three lists of equipment. The first list is for a shop doing *limited* automotive painting. That is, primarily touch-up work and only occasional complete refinish jobs. The second list includes the basic equipment for *average* automotive painting; which is understood to mean not more than two complete refinish jobs per day. The third list includes the equipment for *extensive* automotive painting, consisting of three or more complete refinish jobs each day.

Limited Equipment

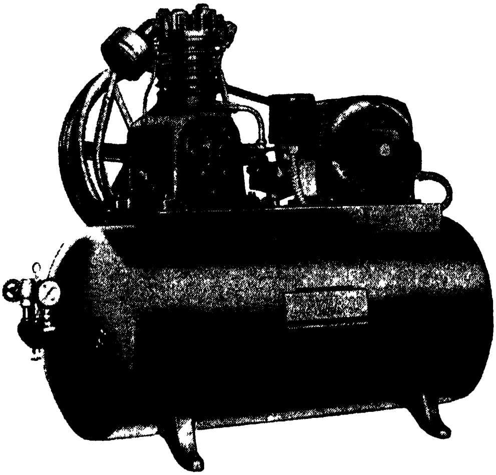


Fig. 197. Air compressing outfit.

Air Compressing Outfit

Two cylinder, two stage, two horsepower air compressor delivers 8.63 c.f.m. at 175 pounds pressure to operate the commonly used shop tools and spray guns.

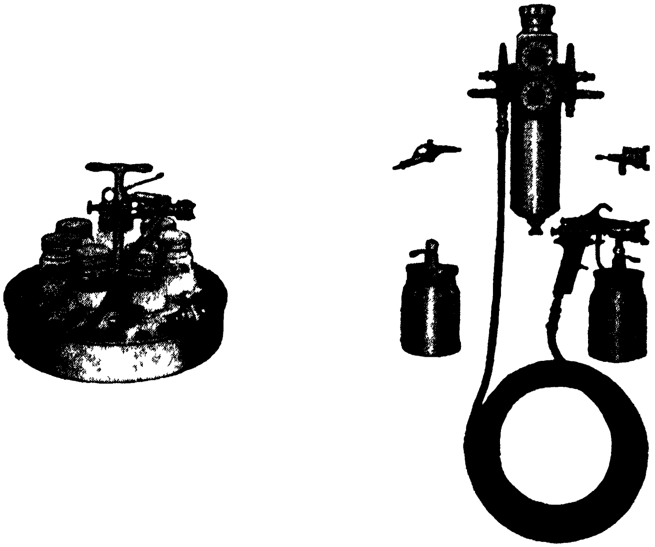


Fig. 198. Spray painting outfit.

Spray Painting Outfit

An assembly of the minimum production-type spray equipment for shops doing general body repair and occasional complete refinishing. The outfit consists of: 1 production type spray gun with quart suction feed cup attachment and quick air connector; 1 removable spray head together with a second suction feed cup assembly; 1 combination air pressure regulator and air cleaner (air transformer); one 25 ft. length of 5/16″ air hose equipped with quick connector; and a complete general purpose touch-up outfit. This touch-up outfit includes: 1 precision type touch-up gun with glass cup; 6 extra glass cups with sealing lids; 1 tray for the outfit; 1 fifteen foot length of 1/4″ braid-covered air hose with connections; 1 air cock for main line; and 1 hose coupling.

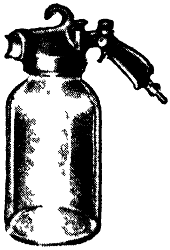


Fig. 199. Flock spray gun.

Flock Spray Gun

Applies all types of flock in uniform coverings. Fully adjustable for amount of flock sprayed and for the shape and size of spray pattern. Equipped with 2 quart glass jar (mason jar threads).

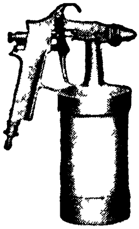


Fig 200. Underbody patching gun.

Underbody Patching Gun

For use in the body shop to replace small areas of underbody coating that have been removed for repairs. Also for use with other types of sound deadeners, dum-dum and adhesives. Equipped with 2 quart metal cup.

Exhaust Fan

One horsepower, 24″ diameter fan provides ample air flow to properly exhaust a good-size spraying area. It

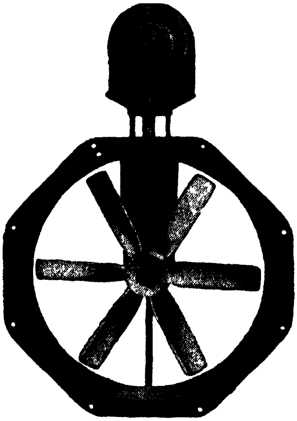


Fig. 201. Exhaust fan.

combines with a mounting assembly to form an easily-installed unit. The fan bearings, belts, and pulley are sealed into a housing to insure long, trouble-free service.

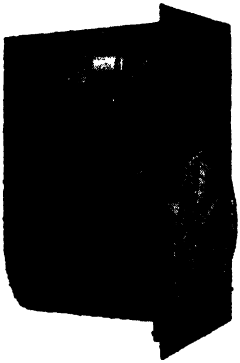


Fig. 202. Window and wall mounting.

Window and Wall Mounting

Proper exhaust equipment for shops not doing sufficient work to warrant a spray booth. It is installed in the wall or window of an enclosed area to exhaust directly to the outside, or to be connected to 24″ exhaust piping. It is built to accommodate the fan and includes protector screen and service door.

Average Equipment

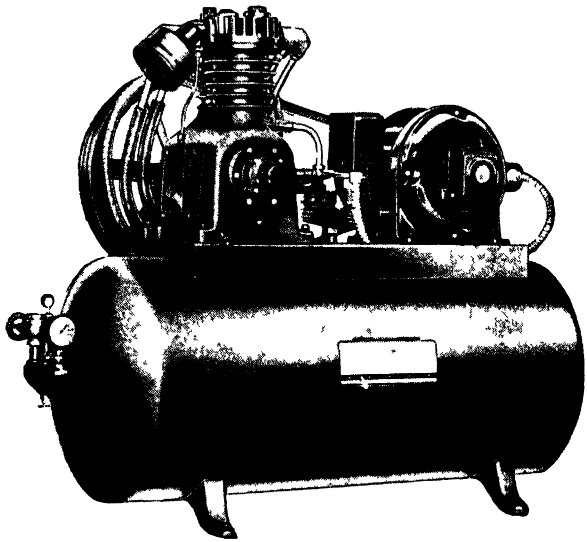


Fig. 203. Air compressing outfit.

Air Compressing Outfit

Two cylinder, two stage, 5 horsepower air compressor. Delivers 17.26 c.f.m. at 175 pounds pressure to operate spray guns and all types of pneumatic shop tools at peak efficiency for intermittent service.

Spray Painting Outfit

A complete production painting and touch-up equipment combination for automotive refinishing. Makes possible factory quality finishes and production line speed for repair and refinishing departments. The outfit consists of: 2 production-type spray guns with quart suction feed cup attachments; 6 extra cups with sealing covers (not shown); 2 quick connector stems for spray guns; 1 combination air pressure regulator and air cleaner (air transformer) with automatic water drain; 1 radiator core spray gun with quick connector; 1 air dusting gun with quick connector; 2 twenty-five foot lengths of tough, non-kinking 5/16″ air

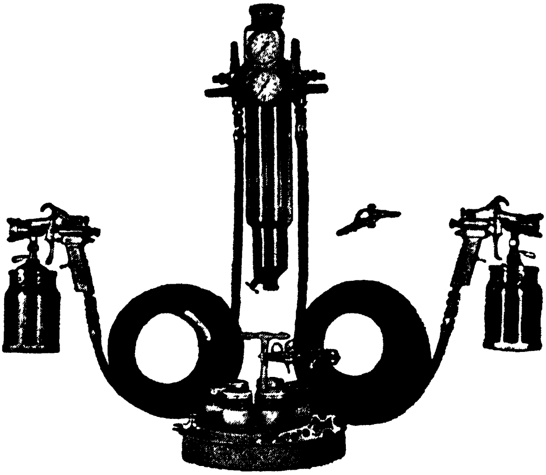


Fig. 204. Spray painting outfit.

hose with quick connection; and a complete general purpose type touch-up outfit. This touch-up outfit includes: 1 precision-type touch-up gun with glass cup; 6 extra glass cups with sealing lids; 1 tray for the outfit; 1 fifteen foot length of ¼″ braid-covered air hose with connections; 1 air cock for main line; and 1 hose coupling.

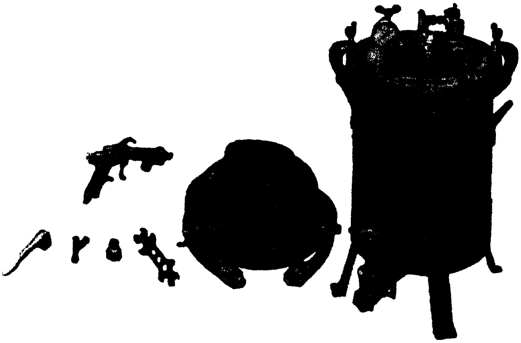


Fig. 205. Underbody coating outfit.

Underbody Coating Outfit

Specially designed 10 gallon pressure feed tank system for fast, economical application of underbody coating and other heavy materials. Fully equipped with pressure regulator and gage; valves and fittings; spray gun with special heavy materials spray head; and 15′ lengths of air and material hoses.

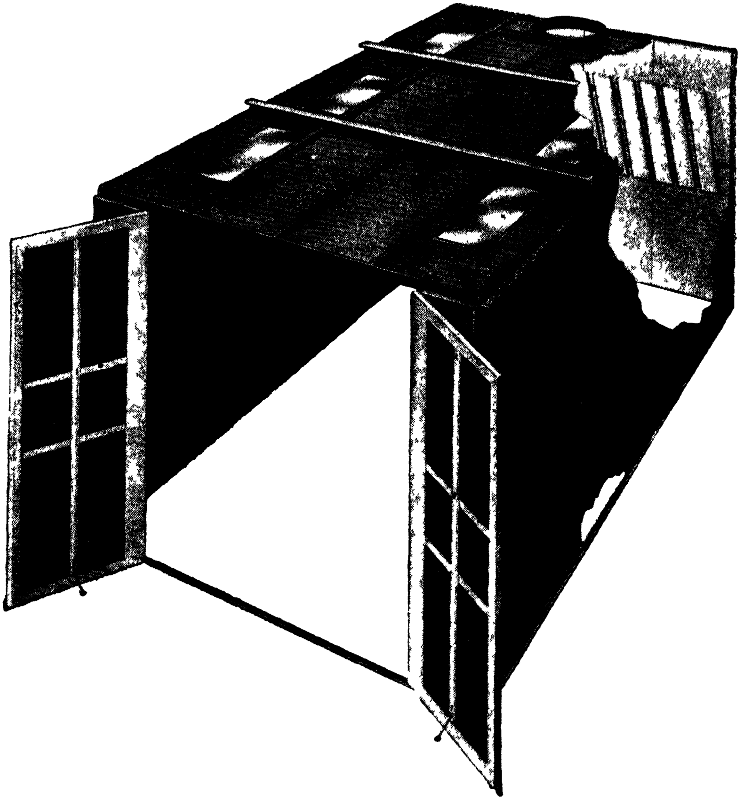


Fig. 206. Standard automotive booth.

Standard Automotive Booth

Standard all-metal spray booth. Large filter-type doors; sealed glass openings for six special fluorescent light fixtures; scientific exhaust air distribution; and simple panel-type construction. Booth is 12′ wide, 24′ long, and 9′ high. Exhaust outlet is interchangeable, either top or back. Note: for use in New York State this same type of booth 26′ long is required. Be sure to obtain information on your local and state requirements and see to it these are followed.

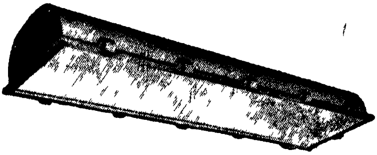


Fig. 207. Fluorescent light fixtures.

Fluorescent Light Fixtures

Specially designed for spray booth service with sealed metal housing and glass cover to keep individual reflectors clean and free of vapors. Mounted for servicing from outside the booth.

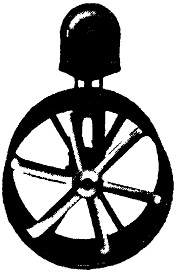


Fig. 208. Exhaust fan.

Exhaust Fan

Three-quarter horsepower, 34″ diameter, ball-bearing fan provides air circulation through the booth. Designed specially for spray booth service, the bearings, belts, and pulley are in a sealed housing. Fan can be installed in either vertical or horizontal position. Note: for use in New York State 1½ horsepower fan is required.

Exhaust Stack Components

Seldom are two booth installations alike, as in the construction, ceiling, height, etc., of the building in which the booth is placed vary widely. However, a typical installation requires the following: 3 lengths of straight pipe; 1 automatic damper, clean-out door, and pipe assembly; 1 weather cap; 1 fan support; 1 motor house; 1 stack band; 2 fan connecting rings; 1 set of guy wires and underbody patching gun and flock spray gun as in Figs. 199, 200.

Extensive Equipment

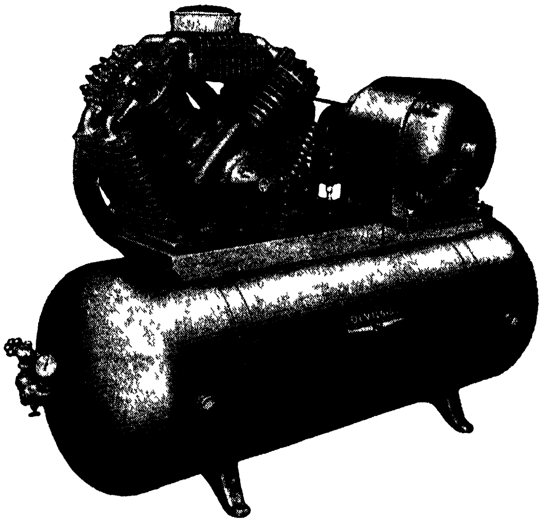


Fig. 209. Air compressing outfit

Air Compressing Outfit

Four cylinder, "V" type, 2 stage, 10 horsepower air compressor. Delivers 37.6 c.f.m. at 175 pounds pressure. Capacity is ample for simultaneous use of several spray guns, body bumpers, grease guns, pneumatic tools.

Underbody Coating Outfit

Pumps direct from original 55 gallon container. Two independent regulators make ideal spraying possible under varying job conditions. Powerful pump is simple and economical to operate and built to give heavy duty service. The complete outfit consists of: 1 heavy duty pump, controls, suction tube and barrel lid assembly; 1 twenty-five foot length 5/16″ air hose with connections; 1 twenty-five foot length 3/4″ specially compounded synthetic fluid hose with connections; 1 fifteen foot length 7/16″ air hose to connect outfit to supply line; 1 air cock; and 1 special heavy body materials spray gun with removable head.

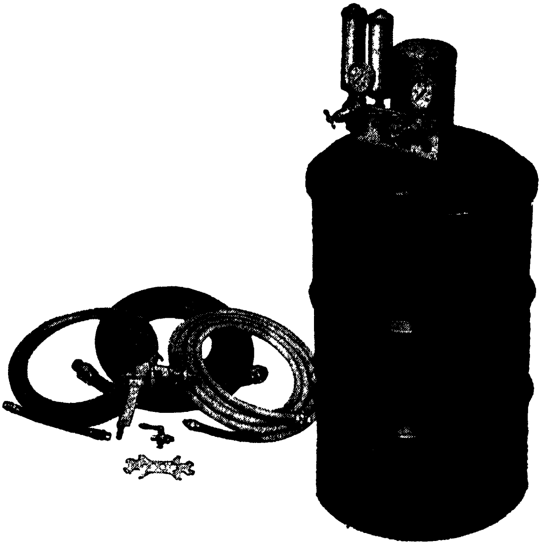


Fig. 210. Underbody coating outfit.

Showroom Booth (Not illustrated)

A forceful service merchandiser with six large windows for your customers to watch the fascinating process of spray finishing a car. Booth is 28′ long, 14′ wide, 9′ high and is equipped with: large filter doors at one end and drive through doors at the other; service door for personnel; six windows, and twelve sealed glass openings for fluorescent light fixtures. Exhaust outlet is interchangeable, either top or back. This same type booth is available as a large combination truck and auto refinishing booth.

Auto Oven (Not illustrated)

This convection-type, gas-fired oven assures uniform, clean heat completely on every surface of the car—back and front as well as sides and top—so every inch dries to the same degree of hardness at the same temperature. One day refinishing service is practical. No tying up the spray booth for long drying periods. When the car is sprayed, it is placed in the Auto Oven—and in 45 minutes the film is set. Inside clearance of the oven: 22′6″ long; 9′0″ wide; 8′0″ high. Equipped with: large drive through doors at both ends; air recirculating fan; heating unit; and approved type automatic temperature controls for any specified type of fuel gas.

Tunnel (Not illustrated)

Complete, tightly sealed enclosure for connecting oven to spray booth. Tunnel is 6′ long, 10′ wide, and 9′ high.

Due to the increased volume possible when using the showroom booth and the auto oven, it is understandable that a larger compressor is needed. With the larger volume of work it is also possible to sell an increased number of undercoating jobs. Hence the large-capacity undercoating equipment. These units plus the special booths comprise the main difference between this *extensive* list and the *average* list on the preceding pages. The *extensive* list includes the underbody patching gun, flock spray gun, fluorescent lighting fixtures, and exhaust stack components already described. The exhaust fan is similar but has a more powerful motor.

CHAPTER XXV

SURFACE PREPARATION

The recommendations given here are based on experience of the du Pont organization. Trade names used refer mostly to du Pont products. Other organizations, naturally, offer materials to do the same job under different names.

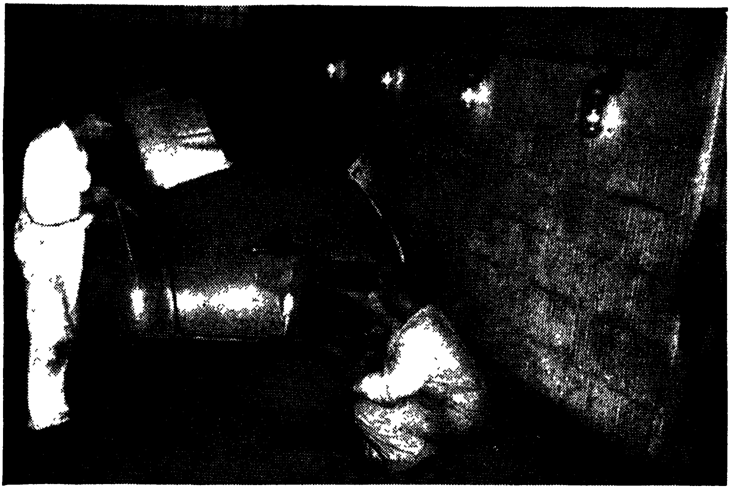


Fig. 211. Washing down an area to be touched up.

Your nearest automotive jobber can acquaint you with the various kinds of refinishing material on the market.

One word of caution, however: In general *don't mix brands.* Though two brands of material may be of comparable quality they may not ''get along'' with each other. This is especially true of the finishes and their thinners.

Before any sanding is done in connection with touching up of passenger cars, wipe surface to be painted with a clean cloth soaked with benzine or commercial solvent to remove all traces of wax, polish, and grease. Cut down the edges of broken spots with coarse sandpaper or with lacquer-removing solvent if the old finish is lacquer, and feather the edges with 400 paper. Treat any rusty metal with a metal conditioner such as "Metalprep," "Deoxidine," etc. Wash with water (Fig. 211), dry thoroughly, immediately spot spray bare and feathered areas with primer-surfacer and then sand smooth. Rub edges of patches with rubbing compound to remove scratches in old finish, and overspray. Then spray over area to be patched one medium coat of Pyra-Prep or equivalent, reduced 1 part Pyra-Prep with up to 1½ parts thinner. Allow to dry at least thirty minutes to secure maximum sealing. If necessary, scuff lightly to remove nibs (Fig. 213).

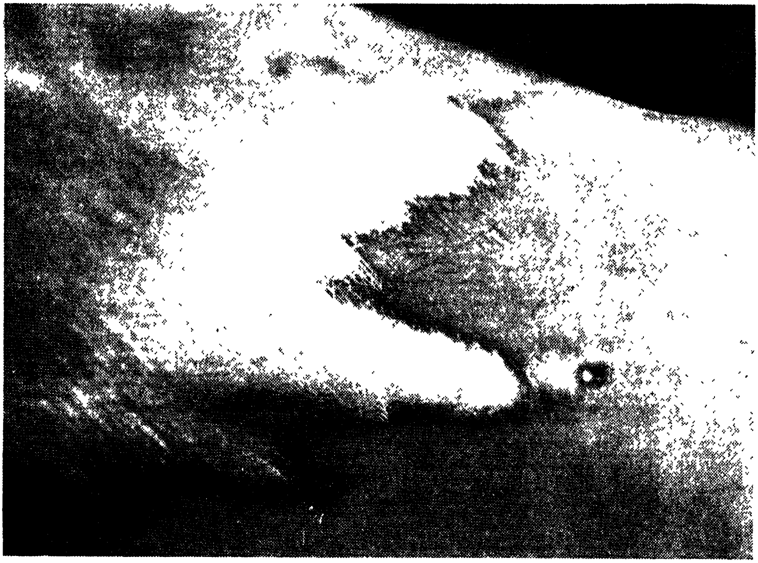


Fig. 212. Applying the primer promptly protects bare steel against rusting.

Metal Treatment

All metallic surfaces should be carefully cleansed with solvent such as cleaners' naphtha to remove any grease, oil, or other foreign matter that might be present. In some instances, as noted in the following discussion, it is desirable to thoroughly treat the surface with metal conditioner.

1. Uncoated Body Steel.—It is strongly recommended that uncoated body steel be sanded before priming, preferably with a metal conditioner such as "Deoxidine," "Metalprep," etc. When steel is prepared for priming, the primer should be applied at once (Fig. 212). Do not let the metal stand without primer, as rusting starts immediately, causing poor adhesion.

2. Zinc Coated Metals.—There are numerous zinc coated metals on the market ranging from untreated Spangled Galvanized Iron (hot dipped) to the phosphate coated electrolytically deposited zinc sheets. The adhesion retention and durability of finishing systems over these metals will range from poor to good depending upon the particular metal involved. The following groups or classifications list the precautions, special treatments required, or specific finish systems necessary to give best results.

As a rule, these metals should not be sanded or treated with acid type cleaners since they will remove either the phosphate coating if present or, in the case of electrolytic sheets, the thin coating of zinc.

a. Spangled Galvanized Iron.—Experience shows that this metal is one of the most difficult metals to finish in order to secure satisfactory adhesion. Although sanding with fine sandpaper and cleaners' naphtha sometimes improves adhesion, very inconsistent results may occur. Finishes of satisfactory adhesion immediately after application may become very brittle after several months' aging. The recommended system for finishing this type of metal is first remove grease, dirt, and other foreign matter with cleaners' naphtha and apply one light coat of 67-747 Spangled Galvanized Iron Primer. Allow to dry at least eighteen hours and follow with surfacing coats of Preparakote.

b. Treated Spangled Galvanized Iron.—Sheets such as "Paint Grip," "Zinc Grip-Paint Grip," etc., are phosphate coated at the time of manufacture. These sheets normally do not require any special treatment other than removal of grease, dirt, or other foreign matter. If the surface is mechanically abraded or the phosphate coating removed by spot welding, etc., it is advisable to treat the sheet with one of the metal conditioners such as "Lithoform No. 2," or "Galvaprep." Apply one light coat of 67-747 Spangled Galvanized Iron Primer. Allow to dry at least 18 hours and follow with surfacing coats of Preparakote.

c. Galvanneal.—This is a specially processed galvanized iron to give improved adhesion. No special treatment is required other than the use of cleaners' naphtha to insure a clean surface. Prime and surface with Preparakote.

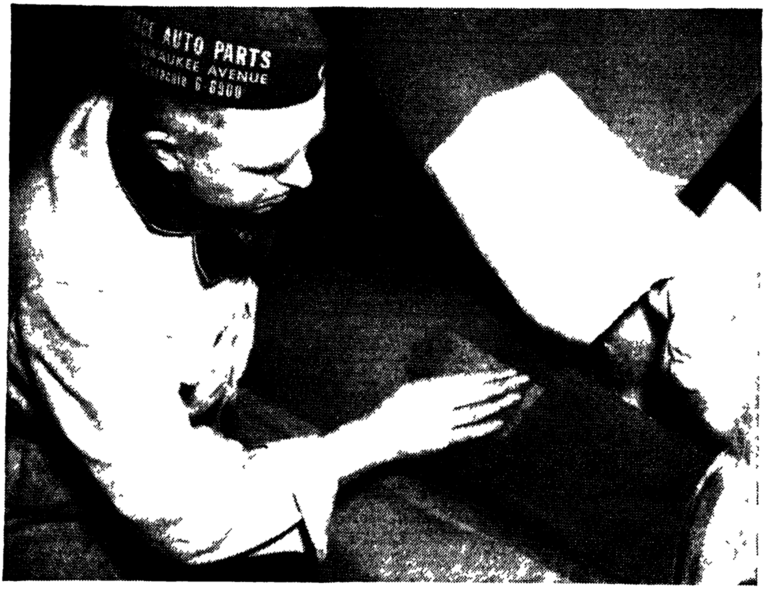


Fig. 213. Sanding lightly to remove the nibs.

d. Non-Spangled Galvanized Iron.—Representative of this group are the electrolytically zinc coated sheets which are generally phosphate treated at the mill, such as "Paint Lok," "Cold-rolled Paint Grip," and "Weirzin." Some variations in adhesion to these surfaces have been noticed and treatment with "Lithoform No. 2" or "Galvaprep" may be used to obtain uniform results. Preparakote is recommended as a primer and surfacer for these metals.

3. Aluminum.—Wash with cleaners' naphtha and treat with a metal conditioner such as "Alumi-prep," "Alodine," or "Deoxidine." Do not sand. In building truck bodies of aluminum it has been found desirable to prevent corrosion on the inside of the sheets by spraying a coat of 63-111 Zinc Chromate Primer, permitting hard dry before assembly to prevent a rapid corrosion resulting from electrolysis. Prime and surface outside of sheets with a minimum of two spray coats of Preparakote.

4. "Dowmetal."—This metal is a magnesium alloy, manufactured by the Dow Chemical Co. During manufacture it is given a chrome-pickle treatment which is necessary to secure adhesion of the finish. Where the chrome-pickle layer has been removed by sanding or damaged in any way, it is imperative that the metal be sanded and then well brushed with a generous amount of chrome-pickle solution freshly prepared in accordance with the formula given below. Aluminum, glass, or earthenware containers may be used and the solution may be applied with an old but clean paint brush. It is advisable for the operator to wear rubber gloves. Sodium Bichromate ($Na_2Cr_2O_7 \cdot 2H_2O$) 1.5 lbs., Concentrated Nitric Acid (Sp Gr 1.42) 1.5 lbs., Water to make 1.0 gal.

The solution should be well worked into the metal and should be allowed to remain in contact for at least 1 minute. The residual solution must be washed off with water. Do not allow solution to become trapped in joints, etc. When the metal is dry, prime and surface with Preparakote.

5. Stainless Steel.—Dry sand thoroughly with No. 280 paper and wash with cleaners' naphtha. Prime and surface with Preparakote.

CHAPTER XXVI

PRIMING AND SURFACING

With the metal in as good condition as it is possible to get it, the next step is to spray on the priming coat.

This coat gets a "toe hold" on the metal and helps the following coats to be permanent by furnishing a surface to which they will adhere. That is the only job the priming coat has to do. But even a special primer cannot "hold on" if the metal is not thoroughly clean.

In general there are two kinds of primers—oil base and lacquer base.

Neither primer will prove permanent on a surface that is not well cleaned up. However, of the two kinds of primers, the one with the oil base has the ability to absorb a *slight* amount of oil film from the surface of the metal. This is due to its slower drying characteristic. The lacquer base primer dries so fast that it has practically no time to absorb any oil film that might be on the metal.

However, even if an oil base primer is used *do not* expect it to prove permanent unless the surfaces are cleaned up to the very best of your ability. More refinishing jobs are ruined by the workman being too anxious to start spraying than from any other cause. Good refinishing is more dependent upon careful work in the preparation of the surfaces than upon great skill in spraying, though the latter is important, of course.

Many consider it best to use an oil-base primer, for while it delays the work a few hours by its slower drying, it does much to assure a permanently satisfactory finish.

This oil base prime coat should be sprayed with the material as it comes from the can. However, if it is too thick to handle well, it may be thinned with **turpentine.**

It is well at this time to mention that the final result depends as much on the quality and suitability of the materials used as upon any other factor. Furthermore, there is so little difference in price between the best grades of the various kinds of material and the cheapest that it is folly to risk the quality of the job for a few cents' saving in material.

And in buying materials it is well to use the products of but one manufacturer—at least on any one job. The products of different manufacturers may be of equally high grade, but by using one brand from prime coat to rubbing compound you know that you have materials that were produced to work together, and if they fail, there can be no "buck passing." In the use of thinner particularly, it is important to use the same brand as the lacquer you are using.

Above all, follow the recommendations of the manufacturer. He knows from experience and research just how each product should be handled. And only by seeing that you use his product successfully can he hope for your continued business. For that reason you may be sure that his recommendations are sincere and should be followed to the letter.

Smoothing the Surface

File marks and other imperfections in the surface of the metal must be filled in with putty or they will appear in the finished job. Glazing putty for filling such defects is on the market in handy tubes, as well as in pound and larger size containers.

Some shops make a practice of spraying the entire job with a coat of surfacer and then going over all surfaces with a flexible putty knife and glazing putty to fill the deeper imperfections.

Other shops do the spot puttying first, and then spray on the surfacer. It makes little difference which method is used. They are both good. The difference in results in various jobs would come only from a difference in thoroughness with which the work was done, not from any difference in methods.

If the whole job is first sprayed, then puttied, it should be given another spraying or two of surfacer after the putty has dried and has been sanded smooth.

To save time, some establishments try to finish the hand putty work near closing time. The reason for this is that the putty takes about 8 hours to dry; so, by following this plan, the car is ready to work on the next morning.

The final undercoat is another spraying of surfacer.

Surfacers—like primers—are available in either oil type base or pyroxylin base. The oil type base offers greatest flexibility and is especially suitable for use over wood. This surfacer is also excellent for use on metal but requires longer time in which to dry than does the pyroxylin base surfacer.

Oil base surfacers take about 6 hours to dry, so it is possible to put on two of these coats in a day—letting the last coat dry over night.

Another coat in the morning will finish the job of surfacing, except for the sanding. And there is the *job*. When this last coat of surfacer is thoroughly dry, the car must be wet sanded with No. 220 waterproof paper to avoid scratching. To finish up, No. 280 waterproof paper should be used.

Then if any scratches or other defects appear in the surface, they should be spot puttied. When dry they should be wet sanded with No. 280 waterproof paper.

The next step is to sponge down the whole car with clear water to carry away any slop and dirt from the sanding operation. Watch the corners and cracks. Remember that any dirt dropping out later—or moisture remaining in such places—will ruin an otherwise good refinishing job. With compressed air, blow out all cracks and corners. And with chamois, go over every surface that can be reached.

Then let the car stand over night and it will be ready for the first coats of lacquer in the morning.

CHAPTER XXVII

SPRAYING LACQUER AND SYNTHETIC ENAMEL

The very first step in spraying is to be thoroughly familiar with your air brush, or gun. Know its ability—and limitations. And the best way to know all about it is to **use** it. But don't try it out on the car. Use an old fender, or any old piece of sheet iron.

If you have just purchased a new gun, read everything the manufacturer says about it. The man who designed the gun knows lots more about it than anyone else. And he wants you to know just as much about it. If you do, you will get results. Then you both win. If you don't read and heed the instructions, you will be disappointed in the gun. Then you both lose.

Whatever the make of gun you choose, remember this: it is a fine instrument. Treat it as such and it will give you fine service. Neglect it, and it will cause no end of trouble. And the main matter to watch in taking care of any gun is to keep it clean. Also, put a drop of light oil on the moving parts every week. This simple service will make the gun last much longer than it would if you failed to give it this slight attention.

When you finish spraying for the day—or change colors—put thinner in the cup and work the trigger until the spray coming from the gun is entirely free of color. Some operators make it a practice to soak their guns in thinner. That is not the best method. The thinner tends to destroy packing in the gun. Furthermore, it is an unnecessary fire hazard. And there is no need of soaking the gun if thinner is shot through it while the lacquer is still soft. Should a pressure tank and hose be used, all paint should be blown from the hose and then thinner should be run through it, by working the gun, until there is no trace of color in the mist coming from the gun.

Before starting to spray, be sure that you have the air pressure recommended for the gun you have and the material you are using. Gun manufacturers specify the pressure to use. Insufficient pressure may result in poor breaking up of the material: excessive pressure will cause loss of material through "dusting." Either too much or too little pressure will cause an unsatisfactory finish. The "orange peel" effect is commonly the result of too much pressure, though insufficient thinner might be the cause. A pressure between 55 and 75 pounds is approximately correct, but the exact figure will depend on the gun and the material you are using.

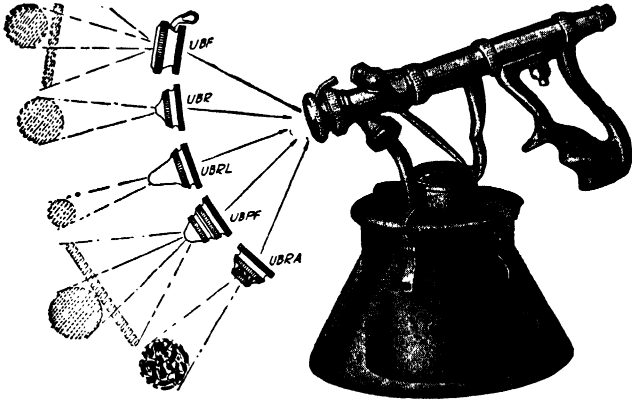


Fig. 216. Various patterns made by one airbrush. Know your gun before attempting to use it on a job.

There are important differences between handling lacquer and handling synthetic enamel. Lacquer is more fluid and more volatile than synthetic enamel. Consequently lacquer is sprayed with an air pressure around 45 to 50 pounds, while 60 to 70 pounds is generally needed for synthetic enamel. Due to the volatility of lacquer, the gun is held closer to the surface—a distance of 6 or 8 inches being preferred. With synthetic enamel it is best to keep the gun 8 to 12 inches from the surface. Working too close with either finish is likely to cause a wet, heavy area that may sag, though the hazard is greater when working with synthetic enamel.

The drying is very rapid with lacquer, so holding the gun too far back will cause the material to dry in the air, resulting in a rough surface. There is less tendency for synthetic enamel to do this.

The action of either product is influenced by the manner of thinning, the lacquers usually being thinned with 1½ to 2 units of thinner for each unit of lacquer. With synthetic enamels there is generally 1 unit of thinner to 5 units of enamel. It is interesting to note that since there is more solid material in the enamel, one enamel coat is equivalent to several coats of lacquer. Commonly a lacquer finish consists of 3 or 4 double coats. A double coat is generally considered to be the result of covering the surface first with overlapping horizontal strokes and then with a series of overlapping vertical strokes. Studying the spray pattern will determine how much to overlap. Very commonly the spray pattern can be thought of as being in three sections: The center one-third if correct will cause the outer thirds to thin. And if, therefore, the strokes are overlapped by this amount, the entire coat will be of uniform thickness.

In handling polychromatic finishes, that is those that have the metallic powder in them, lacquers should be applied with one fairly heavy wet coat followed up by two or three mist coats. This is just the opposite of applying the straight lacquer finishes, which should be put on with a thin coat first followed by wetter coats.

In handling the polychromatic synthetic enamels, there should first be a heavy coat sprayed on—being very careful not to get it so heavy as to cause it to sag, and then this should be followed by a thin coat.

The manner in which these two finishes dry differs widely. Lacquers dry by evaporation, and can be polished under normal conditions in about 1 hour. Synthetic enamels have a preliminary drying by evaporation and then harden through oxidation of the oil. No polishing should be attempted for 48 hours unless the job has been oven dried. And even then, sanding or polishing tends to remove and ruin the sealing effect of the synthetic enamel and thereby reduce its durability.

In using a spray gun or in applying a finish, always remember that the manufacturer can be no more successful in *selling* his product than you are in *using* it. Accordingly, he always gives the latest and very best advice. In purchasing a new gun, search for the instruction slip that accompanies it. In buying a container of paint or thinner, observe the instructions. They are the best information that you can get.

In thinning any material a little experimenting will be in order. There is a difference in thinners and only by experience can you know the exact quantity to use. This is especially true when spraying heavy material to obtain a glossy surface. Under such circumstances it will probably be necessary to increase the air pressure. And the greater flow of air accelerates the evaporation of the solvents. This lets the material strike the surface in a somewhat gummy condition with the result that it does not flow out smooth but becomes mottled. More thinner is one way of curing this difficulty. Higher quality thinner, rich in slow-drying solvent is probably the better—and no more expensive—way of getting the desired effect.

So the quality of the thinner you are using does make a difference in the quantity needed for any specific application. Test mixes are worth while. Watching the proportion, prepare a small quantity of material and try it on some old part. If it is difficult to apply, gives an uneven effect, add more thinner. If it fails to cover the surface or tends to be iridescent—has "rainbow colors"—too much thinner has been used.

When the proper porportions are found, make note of them and use the same proportion for each mix.

Now get acquainted with your gun. Get the "feel" of it.

Holding it near a practice surface, gently squeeze the trigger as you sweep your arm across the panel. For flat surfaces the gun should be adjusted to give a "fan" shaped spray. A well-adjusted spray will have quite uniform distribution of material. However, the outer ends of the fan will have less material than the center. If the fan is covering a 6-inch width, the outer 2 inches of each end will be fairly light. The center 2 inches will be quite "wet." In working the gun, keep all strokes parallel and overlap each stroke so that the material is of uniform thickness. Stop the flow of material at the end of each stroke or runs will result. That is the secret of successful spraying—the achievement comes with practice.

Three to five coats if using lacquer should be sprayed onto the body, hood, and fenders, too, if they are to be the same color. If a different color is to be used on certain parts, masking will be required—but more on that subject, later.

The first coat should be very light. If too much material is sprayed on, it will tend to raise the oil undercoats. For that reason, have your material quite thin, and spray on but a mist the first time.

About 30 to 60 minutes should elapse between coats. However, if you are working alone on the car, your spraying can be practically without interruption. By starting, let us say, at the right front fender and working all the way around the car, it will take 30 to 60 minutes. Then you'll be ready to start the next coat at the right front fender.

Before going ahead with this, however, it is best to give the chassis, running gear, and under side of fenders two coats of chassis gloss black. The reason for doing this now is to guard against the harm that would result from the black blowing onto the finish of the upper part of the car. Of course, the spraying of the under part of the job may be done at any convenient time after having been washed and wiped off with gasoline. Also, if the engine is to be refinished, it can be given a coat of gray engine enamel when the chassis is being taken care of.

In spraying the upper part of the car, hold the gun at a uniform distance of 6 to 8 inches from the surface for lacquer and 8 to 12 inches for enamel. Do not use your arm as a radius, thus drawing the gun away from the work at the end of each stroke. Be sure the gun follows the curve of the body—not the arc of your arm. See Fig. 217.

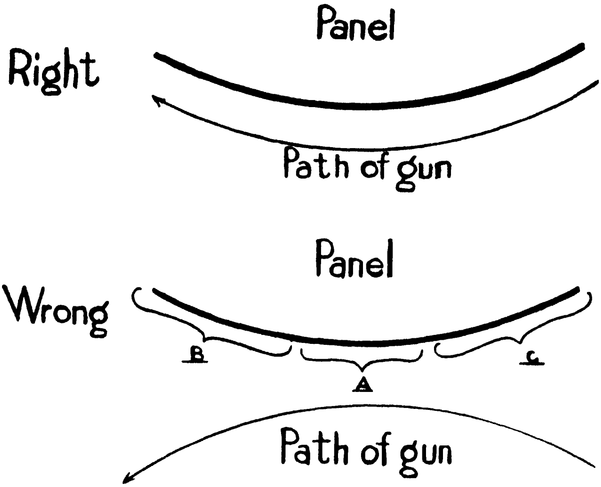


Fig. 217. Graphic illustration of the right and wrong ways of moving the spray gun with relation to the work.

In Fig. 217 two identical panels are represented. In the upper, the gun is held at the right distance and the material started as the gun approaches the panel and stopped as the end of the panel is passed. The result is as it should be.

In the lower, the gun is swung with the operator's arm as a radius. Even though the material is started and stopped at the right time, the sections indicated by *B* and *C* will be rough, and *A* will probably have runs in it.

Holding the gun even a little too far away creates excessive finish dust and causes a rough surface. Holding the gun closer lets the finish strike the surface while too wet, thus tending to cause runs. Other things that cause runs is the use of too much thinner in the material or holding the gun in one spot.

And runs cannot be wiped out. Lacquer, unlike enamel, softens the under coats and becomes a part of them. That is a great advantage in the final finish, but a great disadvantage when runs occur, for it means that attempting to wipe the runs out may take off the finish down to the metal.

Fig. 218. Time is saved with this equipment that combines masking tape with brown paper.

The only way to take out a run is to let it dry thoroughly and then sand the spot smooth. This is done, of course, before the final coat is applied.

But until you are thoroughly experienced in mixing lacquer and enamel and in handling the gun, practice on junk pieces whenever you can. Some operators keep an old fender handy to use as a "target" to try out new mixtures—or different gun adjustments. It might be worth your while to do the same thing and thus avoid the chance of creating runs or sags in the finish of your work.

Masking for Two-Tone Work

Any painter's supply store can furnish masking compound, masking tape, and paper. Newspapers can be used, but there is the danger of its printing on the surface of the car if much lacquer is sprayed against the outer side. The thinner has been known to soften the ink on the newspaper, thus making it print. Brown paper is not very expensive and is much more convenient than newspaper, being larger and stronger.

Masking compound is used on windows before doing any spraying. This compound can also be used to protect metal parts that are not to be sprayed. And some operators use it to protect the body itself in two-tone work. However, to get sharp edges it is necessary to finish off with tape.

After the parts that are *not* to be sprayed are covered, the surfaces that are to receive the other color should be given two or three coats, assuming a lacquer job.

Then let the whole car stand for at least one hour, and then remove tape and paper. The masking compound will wash off with clear cold water. Use nothing but water—but use *plenty* of it. At this time the compound should be removed only from the lacquered surfaces of the body if this method of masking was used. Leave the compound on the windows and metal parts, for a final "flow" coat of lacquer thinner is yet to be applied.

CHAPTER XXVIII

SANDING—STRIPING—RUBBING

If the finish used requires sanding, *go easy,* and use No. 400 paper with plenty of water. The No. 400 grade sandpaper is available only in artificial grit. Sandpapers of the waterproof variety for automotive work are made with two kinds of abrasive—garnet, a natural mineral, and a manufactured abrasive. The papers with the manufactured abrasives generally cost a little more but give longer service. For purposes of comparing the size of abrasive on the two types, the following table in Fig. 219 is compiled:

GARNET ABRASIVE	MANUFACTURED ABRASIVE
	400
	320
8/0	280
7/0	240
6/0	220
5/0	180
4/0	150
3/0	120
2/0	100
1/0	80

Fig. 219. Comparison of natural and artificial sandpaper.

The cost involved in sanding down and rubbing out a spray job is something to consider. Many manufacturers of both lacquers and synthetic enamels produce products which are entirely satisfactory after spraying without any further attention except, perhaps, rubbing to bring up the luster. And even this is not always required. Still, there are many old-time finishers who prefer to finish a job with light sanding and rubbing. Power sanding (Fig. 220) is labor saving, but on a finish job will cut too fast unless extreme care is exercised.

Fig. 220. Power sander in operation.

During the light final sanding with clean water, wipe the body carefully. This wiping should be done as the work progresses.

Then, in order to remove slight scratches and imperfections, apply a mist coat of thinner. This will momentarily soften the surface and flow out the scratches. To make this mist coat most effective, it should be sprayed on at right angles to the sanding strokes. That means that on regular lacquer jobs the gun will be moved from top to bottom of each panel (see Fig. 221) for areas that are sanded from front to back. By spraying in this manner, the air pressure from the gun tends to "blow" the scratches together as the thinner softens the surface.

After this coat of thinner, the car should be allowed to stand over night. If rubbing is started too soon, the greatest brilliance and depth of finish cannot be obtained.

In rubbing the finish, follow carefully the directions that come with the compound you choose to use. There are a number of good rubbing compounds on the market. Be sure to use one that does not scratch the surface but which brings it to a high luster. Such compounds are generally applied with a piece of cheese cloth wrung out in clear water and then saturated with the compound. The material is removed with a dry clean rag.

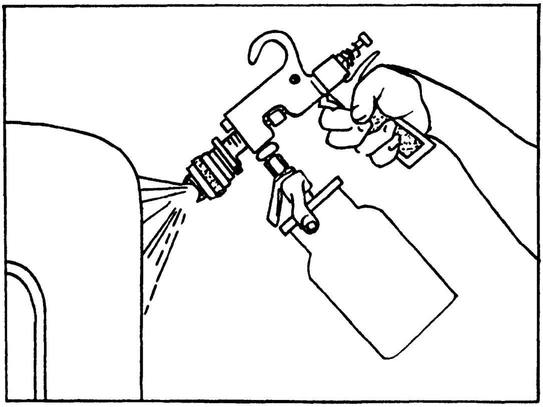


Fig. 221. The final mist coat of thinner. This is sprayed from the top of the car down, as shown.

Never use cloths that are dirty or that have accumulated any grit.

If a power polisher is used, be sure to keep it moving about over the surface. Power polishers are excellent when used intelligently. However, jobs have been ruined by a careless workman letting the buffer run too long in one spot. The power polisher should be so held that the revolving pad makes contact toward the outer edge—thus giving a stroking effect instead of a rotary rub. See Fig. 222.

But even with a power polisher a certain amount of hand

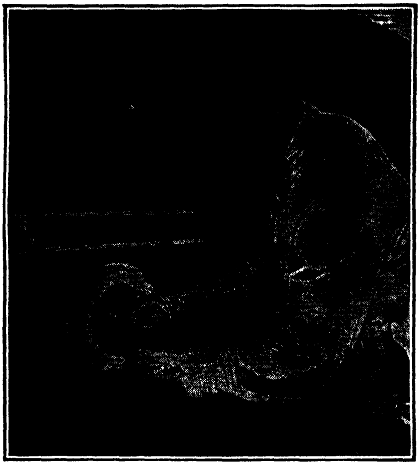


Fig. 222. Using a power polisher on the finished job.

work will have to be done in corners and other places where the machine cannot reach.

Striping

The last operation before reassembling the car is the work of striping. This can be done in several ways, but regardless of materials or equipment used **practice on something before trying to stripe the car.**

As to materials, remember this: if you stripe with a lacquer, it can't be wiped off in case a mistake is made. But with an oil base enamel, you have a chance of wiping the stripe off and starting over if the job doesn't suit you. So, until you are an experienced striper, we would suggest the use of an oil base enamel.

The foregoing remarks apply when the striping is done with a brush. However, if you wish to stripe with a gun, masking tape can be used on the moldings, leaving a space of the desired width where the lacquer spray may lodge. But this system entails considerable work.

In the long run it is wise to buy a pair of high quality striping brushes or striping tool (see Figs. 223 and 224), get some scrap pieces of material to practice on, **and then practice.**

Many expert stripers and all sign painters use a special lettering paint which adheres well, dries with a good gloss, and does not injure the surface underneath. This latter is extremely important when it becomes necessary to correct a mistake made by a slip of the brush.

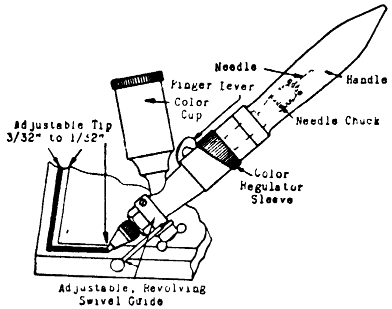


Fig. 223. Striping tool in use.

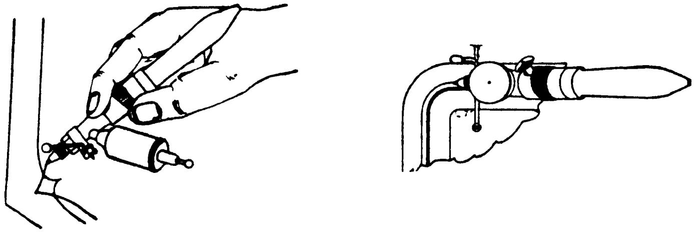


Fig. 224. Both free hand effect in corners, and straight lines are accomplished with these striping tools.

Sign painting requires special skill and practice, and those interested in this extra activity should investigate a regular sign-painters' school (Fig. 225).

The material for striping—whether lacquer or oil base enamel—should be on hand in quantity sufficient for the entire job before starting. The best striping is done quickly. When striping, one brush is left in the striping material

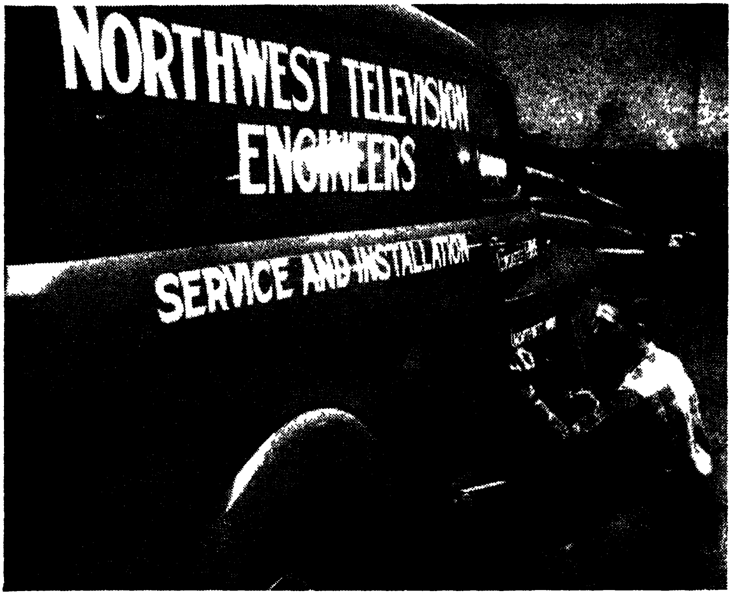


Fig. 225. A good example of inexpensive but neat truck lettering.

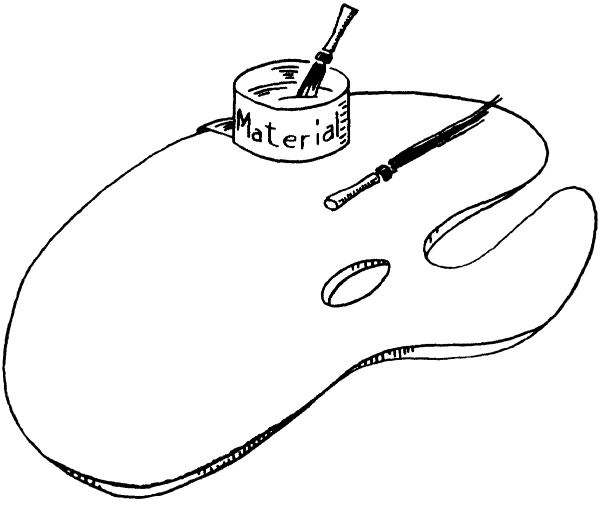


Fig. 226. Artist's palette and two brushes speed the striping job.

while the other is being used. By having the supply of material in a cup on a palette—or little tray—you have something convenient on which to work excess material from the brush before bringing it in contact with the work. See Fig. 226.

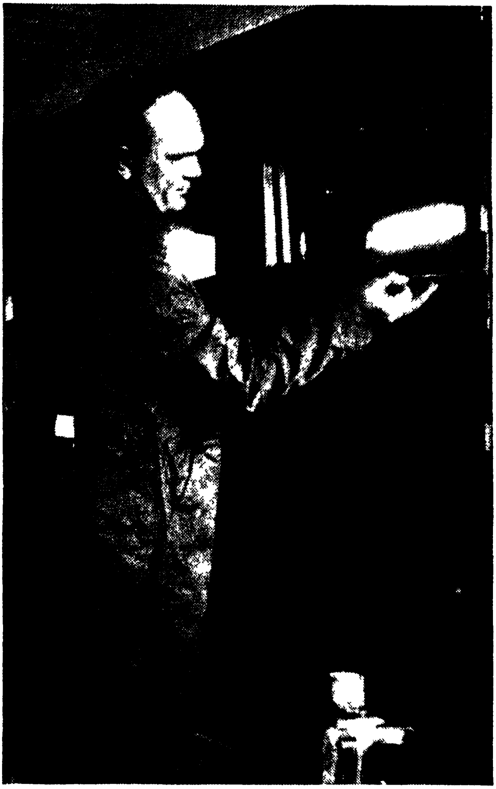


Fig. 227. Striper at work.

With the thumb and the next two fingers gently but firmly grip the brush—about the way a pen is held—and with the remaining fingers guide the hand along the molding. See Fig. 227. The striping should be started at the right front edge of the hood. One line at a time should be run as quickly as possible all the way around the car and finished at the left front edge of the hood.

When striping any surface whatever, each stripe should be completed in one swinging stroke.

As it is obvious that striping is but one coat work, very little polishing should be done on the striping.

Refinishing Wheels

In refinishing metal wheels on the best jobs, it is well worth the trouble and expense to send them out for sand blasting if they are in very bad condition. However, with patience, a motor-driven wire brush or sander will get them in shape for refinishing.

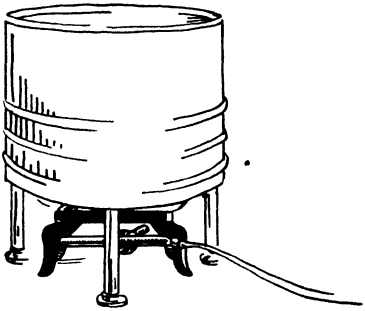


Fig. 228. Oil barrel and gas burner made into boiling vat.

Another method frequently used is that of boiling them in a caustic solution, an old oil barrel sometimes being used as the vat. In Fig. 228 is shown an oil barrel that has been cut off and mounted over a large gas burner to form a small boiling vat. By filling this with caustic solution and boiling the wheels in it—possibly two at a time—all old paint and grease will be removed. Then the wheels should be rinsed with clear water, rust sanded off, and the entire wheel wiped off with a rag moistened with high-test gasoline.

If the wheels are in fair condition, it will be sufficient to sand them well all over.

The simple pipe stand shown in Fig. 229 is made of 1-inch iron pipe and is a big help when working on wheels. The horizontal pipe on which the wheel rests should be about

12 inches long and 40 inches from the floor. The cap on the end of this pipe will be sufficient to keep wheels from slipping off while being turned, provided a little care in handling is exercised.

Regardless of the material of which the wheels are made the next operation is that of spraying on one or more coats of combined oil primer and surfacer. The exact number of coats will depend upon the condition of the surface. After the last coat has been applied, the wheels should be allowed to dry over night. They should be lightly sanded with paper no coarser than No. 280.

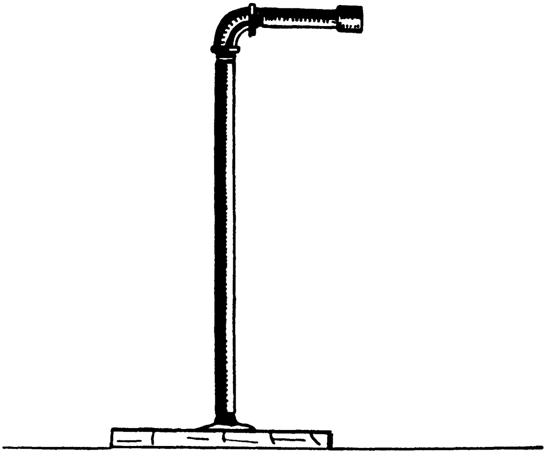


Fig. 229. Wheel rack made of pipe fittings.

Then they may be finished by spraying on two or three coats of finish of the desired shade. Many owners like their wheels striped; and this operation will be handled as desired before the wheels are put back on the car.

Radiator, Top, and Rims

No matter how skillfully you may refinish a car, if you fail to take care of such parts as the top, radiator, rims, tires, instrument board and similar parts, your job will not satisfy.

It is good policy to remove tires from rims while the car is in the shop. The tires should receive a coat of either white, gray or black tire paint. Such paint is available from most paint supply stores in pints, quarts, and larger sizes. It is brushed on.

Rims should be cleaned with a motor-driven wire brush where tire meets the metal and given two coats of aluminum paint—brushed or sprayed on.

Tops should be washed thoroughly, dried, and given two coats of top dressing. Allow 12 hours for the first coat to dry. The leather of open cars should be similarly treated, but with special seat dressing.

Wooden bows for the tops of open cars should be sanded smooth, and if natural finish, given two coats of spar varnish.

Trunks should be refinished the same as the top, if of imitation leather. If of sheet metal, they should be refinished the same as the body.

Radiator cores should be sprayed with a thin mixture of turpentine and lamp black. Never lacquer the core of the radiator or use any heavy paint or enamel on it. Thick paint will insulate the radiator from the cooling effect of the wind and cause the car to boil.

CHAPTER XXIX

PAINTING OVER OLD FINISHES

The subject of completely refinishing a car from the metal out has been covered. However, it frequently happens that the old finish is in such condition—or keeping the cost down is so important—that it is desirable to refinish without stripping the car down to the metal.

Have the car and chassis thoroughly washed—the latter, steam cleaned if possible. Then remove the wheels and all outside hardware such as door handles, lamps, bumpers, etc., and take license plates off.

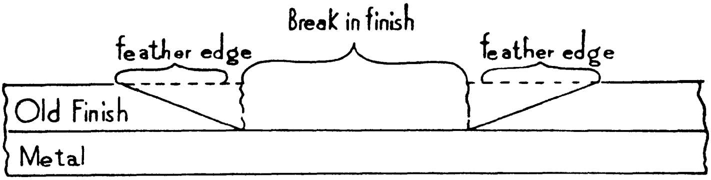


Fig. 230. Exaggerated view showing how a rough break in the finish is sanded to a "feather edge."

The old finish is then sanded thoroughly with No. 400 paper and high test gasoline. Be careful to avoid scratching the surfaces. Now wipe off the car with a clean cloth and pure turpentine or commercial wax remover.

Any rust spots or breaks in the finish must be sanded out to form a feather edge with the old finish. See Fig. 230. Then spot glaze these places with a combined surfacer and primer. When dry, sand to level off with the rest of the finish. Deep, sharp breaks in the finish should be spot puttied and sanded smooth.

Now spray both sides of the fenders and hood and the surfaces of the body with one coat of combined primer and sealer. When this is thoroughly dry, spray on two coats of surfacer. After this has dried it should be sanded down with fine sand paper and all dust blown away and the surface wiped carefully.

From this point on, the refinishing job is identical with the procedure outlined for refinishing a car from the metal out.

Fig. 231. How the sanded spot looks when ready for the surfacer and primer.

Inexpensive Refinishing

While refinishing over the old finish reduces costs somewhat, there is almost as much rubbing as when building up a finish from the bare metal. And rubbing takes time and costs money.

Finish manufacturers have recognized this and have produced lacquers and enamels that can be used with practically no rubbing. Such refinishing is popular with car owners and in the used car departments.

Such refinishing is invariably done over the old finish.

Do not skimp the cleaning job on chassis and motor. Remove door handles and other outside hardware and also wheels. Sand down all surfaces with fine sand paper. Blow off and wipe away all dust.

Touch up all bare metal spots with primer, and when dry give the whole job a coat of combined primer and sealer, sprayed on. If the old finish is very rough a coat of surfacer will also be needed.

Whenever spraying over an old finish, the use of a sealer is very important. This sealer forms a bond between the old and new finishes and keeps the following coats of lacquer from softening the old undercoats. If the undercoats soften, several undesirable things happen. The finish may become roughened—"alligator" surfaced as some call it. Or the finish may not dry as quickly as it should. And if a very heavy first coat of lacquer is sprayed over the old finish, the whole thing may run or sag badly.

After sanding the last undercoat, spray on two coats of black gloss lacquer. Then mask the fenders, splash aprons and other parts that are wanted black on the finished job, and spray the balance of the car with two or three coats of gloss lacquer in the desired color.

This lacquer need not be rubbed, as it dries with a gloss. However, this gloss can be improved by spraying on a light coat of thinner.

The under parts should be sprayed with a coat of chassis black, the body striped, and the job reassembled. Then it may be polished to raise the gloss if desired.

Refinishing right over the old finish is so popular in many sections—and for many reasons—that the step-by-step procedure of two of the outstanding manufacturers of refinishing materials is here given.

From the Duco instructions come the following:

CLASS B JOB

Instructions for Application of Duco Finish Over Old Finish.

OPERATION

No. 1. Remove door handles, license plates, emblems and drop rear fenders. Remove wheels. If steam pressure is available its use will simplify cleaning operation.

No. 2. Clean chassis and underneath fenders and wash body and engine clean.

No. 3. Sand down old finish on the body, using No. 320 paper and gasoline. Dry-sand enamel parts with No. 100 or No. 150 sandpaper.

No. 4. Mask all window and windshield glass. Spray one coat du Pont No. 1538 Pyroxylin Primer or equivalent material over entire job. Allow to dry twenty or thirty minutes and spray on two coats of du Pont surfacer to body, fenders and hood. Dry from one to two hours or longer if necessary.

No. 5. Inspect carefully and fill all defects in surface with du Pont No. 1031 Pyroxylin Putty.

No. 6. Sand out surface with No. 220 wet or dry sandpaper and water, and finish sanding operation with paper No. 280. Wipe off and blow off.

No. 7. Spray fenders, splash aprons and upper structure of body with necessary coats of selected color of Duco, which has been reduced with du Pont Thinner. Dry one hour or longer if necessary.

No. 8. Cover fenders, splash aprons and gas tank with paper, securing with adhesive tape, also mask off upper structure in same manner.

No. 9. Spray hood and body with thin coats of desired color of Duco, reduced to proper spraying consistency by using Duco color and du Pont Thinner. Allow to dry sufficiently and remove masking.

No. 10. Refinish wheels in accordance with specifications under "Wheel Finishing."

No. 11. Polish Duco with du Pont No. 2 Rubbing Compound, reduced with water to a creamy consistency, or du Pont No. 3 Rubbing Compound, reduced with kerosene.

No. 12. Spray chassis, etc., with one coat of du Pont Chassis Black. Stripe with proper color du Pont Striping Duco.

No. 13. Reassemble car and clean up for delivery.

And where the cheapest kind of refinishing job is wanted—especially for cheap used cars—Duco advises as follows:

OPERATION

No. 1. Wash car, chassis and motor. Remove door handles, tires, wheels, etc. Dry-sand body and fenders with paper No. 150. Wipe off and blow off with direct air pressure. Wash surface with high-test gasoline and wipe dry. Cover all glass with du Pont No. 2074 Shieldcote.

No. 2. Touch up bare metal with du Pont No. 1538 Pyroxylin Primer or a good primer-sealer and spray entire body and fenders with a single coat of same material. If thought advisable on account of imperfections in old finish, apply one coat of a good surfacer. Dry one hour or more as required.

No. 3. Dry-sand lightly with No. 280 wet or dry sandpaper. Clean up and blow off dust with direct air pressure.

No. 4. Spray two coats du Pont gloss black, reduced to spraying consistency, on fenders, aprons, gas tank, etc. Allow one hour for drying. Increase gloss by mist coat of thinner, if desired.

No. 5. Mask off fenders, gas tank and aprons with paper and one-inch adhesive tape.

No. 6. Spray on two coats du Pont Used Car Gloss Lacquer of desired color to entire body and hood. This material should not be reduced, as it is furnished at spraying consistency. Increase gloss by mist coat of Thinner. Dry one hour. Used Car Gloss Lacquer should not be rubbed, as it dries with a gloss, which, however, may be increased by polishing with du Pont No. 7 Polish. If preferred, Duco can be used instead of Used Car Gloss Lacquer and the desired gloss obtained by rubbing and polishing in the usual manner, or by spraying a coat of No. 1907 Clear Duco over the entire job.

No. 7. Brush in raised molding with du Pont No. 207-412 Striping Black Duco.

No. 8. Spray on one coat du Pont FV-40 Chassis Black on chassis, gas tank and underneath fenders.

No. 9. If desired, refinish wheels as covered in Chapter V.

No. 10. Clean up and reassemble.

Corresponding refinishing jobs done with Opex lacquers—a product of The Sherwin-Williams Company—are handled as follows:

OPEX METHOD NO. 4

Over Old Paint or Varnish

The success of the application of Opex Enamel over the old paint and varnish depends entirely on the method of application, the condition of the old paint and varnish, and the care of the operator. Thousands of cars have been successfully finished in the following methods over the old finish. We list three methods, each of them having its special interesting feature.

It must be definitely understood, however, that these systems for over the old paint are not offered as a cure-all. The old paint must necessarily be in good condition. If it is peeling or too badly cracked, the paint must be removed to the bare metal. However, for a quick and less expensive method of finishing we know that this system is entirely satisfactory.

PREPARATION

Clean and sand off the car thoroughly. All loose paint, grease, oil and dirt should be removed. The adherence of the product to the old paint will be satisfactory, providing rust, grease, dirt, oil are eliminated. However, if you apply Opex to paint which is almost ready to fall off, there is no reason to expect that the new finish is going to hold the old on. Many refinishers are using ammonia to clean off the varnish and then sand off the remaining color varnish.

1ST OPERATION

Apply one coat Oil Metal Primer and Sealer No. 12 or Opex Clear Binder No. 67.

2ND OPERATION

Apply one light dust coat of Opex Binder Surfacer Gray, Light or Dark, reduced with equal parts of Opex Binder Thinner No. 2. This material dries for recoating and sanding in one hour or more.

3RD OPERATION

Apply heavier successive coats, depending upon the condition of the original finish. Usually two or three coats of Opex Binder Surfacer Gray, Light or Dark, are sufficient to give a foundation which, when sanded out, leaves a perfectly smooth finish ready for the application of the Opex Enamel.

4TH OPERATION

Sand to surface with fine sandpaper. Deep cuts or scratches should be avoided. A hard, glossy surface should be secured.

5TH OPERATION

Apply Opex Enamel two or three coats reduced with Opex Binder Thinner No. 2.

OPEX METHOD NO. 5

For an even quicker and less expensive job the priming coat is eliminated in this method. Of course, if there are any rust spots, these must be sanded out bright and clean and primer applied to the bare metal where exposed.

PREPARATION

Clean and sand off the body and car completely, taking all care suggested with regard to oil, grease, etc., as in Method 4.

1ST OPERATION

Spray one very light or dust coat of Opex Binder Surfacer Gray, Light or Dark, reduced with equal parts of Opex Binder Thinner No. 2 directly over the cleaned and sanded body.

2ND OPERATION

Apply successive heavier coats of Opex Binder Surfacer Gray, Light or Dark, reduced as above, until sufficient material has been applied to fill surface imperfections.

3RD OPERATION

Apply Opex Enamel, reduced with equal parts of Opex Thinner No. 2 same as suggested in previous methods.

OPEX METHOD NO. 6

PREPARATION

At times for the cheapest type of job nothing is desired but a freshening up of the surface after all bare metal spots have been touched up with Oil Metal Primer and Sealer No. 12; Opex Enamel is applied over the old finish without surfacing. The car should be cleaned and prepared the same as in the two previous systems, taking special care that all grease, dirt and oil are removed.

1ST OPERATION

Where the old varnish film is not crazed or cracked, and therefore does not require surfacing, we recommend a coat of Opex Clear Binder No. 67, which serves as a bond coat between the old varnish film and the new lacquer. Opex Clear Binder is an especially designed product to serve this purpose.

2ND OPERATION

Spray one very light dust or mist coat of Opex Enamel, reduced with equal parts of Opex Thinner No. 2. A heavy coat will probably raise the old finish. A dust coat if applied properly will never affect the old finish.

3RD OPERATION

Apply two or three additional but heavier coats of Opex Enamel thinned with Opex Thinner No. 2 and bring up the finish the same as in methods previously described.

CHAPTER XXX

REPAIR WORK—MATCHING COLORS

The first step in refinishing a damaged section is to have the metal ''bumped out'' to its original shape. Then the hammer marks are filled out and the surface sanded down to leave a feather edge with the surrounding finish as was shown in Fig. 230.

The adjoining finish should then be cleaned up with rubbing compound, for age causes discoloration which otherwise makes its difficult to match colors.

Wipe off the whole repair job with a rag moistened with high-test gasoline. Then spray the bare metal with a coat of primer. When dry, apply two or three coats of surfacer. When the surfacer dries, sand with No. 320 paper.

Should the damage be of such a nature that it is impossible to bring the metal to a smooth surface, it will be necessary to putty glaze. If the irregularities are deep it will be best to apply two light applications of putty rather than one thick coat. When the putty is dry, sand until perfectly smooth.

Having determined the original color of the finish, take a suitable quantity of the right shade of lacquer and mix *thoroughly.* Failure to get all of the pigment thoroughly mixed will result in a different shade from the original finish.

Spray the damaged spot with a light coat of this lacquer. When dry, spray the next coat so as to overlap the first coat. When this dries, spray on a mist coat of thinner to blend the edge of the lacquer coat with the original finish.

If possible, let this dry over night. Then rub down the whole section. If the damage was in a fender, polish the whole fender. If in a body panel, polish the whole panel. In fact, some shops prefer to relacquer the whole panel or fender. In this way they get a better match with the color. Or more correctly, any slight difference in shade is not so noticeable when a complete panel or fender is done over.

Following is the step-by-step procedure as recommended by Du Pont for refinishing repair work.

Touch Up and Repair Work Operation

No. 1. On a dented surface, "bump out" the dent so that the original shape of the metal is restored, which should be smooth and free from "waves." See chapter VI for proper procedure.

No. 2. Dry-sand the damaged surface thoroughly with No. 400 sandpaper until perfectly smooth, being careful to feather-edge the Duco surrounding damaged place until a smooth, graduated surface is obtained between the damaged place and surrounding finish, which should be thoroughly cleaned with rubbing compound to bring out the true, original color.

No. 3. After the sanding operation, clean surface thoroughly with a clean rag moist with high-test gasoline.

No. 4. Spot-spray bare metal spots with one coat du Pont No. 1538 Pyroxylin Primer and allow thirty minutes for drying.

No. 5. Spray spot with two or three coats of No. 7886 Hi-Speed Primer-Surfacer or equivalent material. Sand these surfaces when dry with No. 320 sandpaper. No. 7886 Primer-Surfacer should be sanded after a twenty- to thirty-minute drying time, even if still wet. Use only No. 320 paper, and sand lightly.

No. 6. Putty glaze if necessary, using du Pont No. 1031 PX Putty, and allow to dry one hour. If deep glazing is necessary, it is advisable to make two or more applications of putty, allowing for drying thoroughly between coats. Sand to perfectly smooth surface.

No. 7. Spray spot with one coat of Duco of color to match original finish. Be sure that Duco being used is proper color and it is thoroughly mixed, as improper or insufficient mixing will alter the shade. Allow about half hour for drying and apply second coat, extending this coat well past the damaged portion of the job.

No. 8. After last coat of Duco has dried about half hour, apply one mist coat of du Pont No. 3601 Thinner, which serves to blend in the outline of the refinished surface.

No. 9. Allow to dry one to two hours and rub out the spot with Duco Rubbing Compound No. 2 or No. 3 thinned according to directions.

Matching Colors

There are two ways of matching colors: buy them ready mixed or mix them yourself.

But even if you prefer to buy ready mixed colors, it may not always be possible to do so. For that reason it is highly important to have authentic color mixing information available. The following is reprinted by special permission of Sherwin-Williams:

The color of a car on the road for several months cannot be accurately matched up through any standard stock of colors because of the changes that take place upon aging, and thus a perfect match for the original color is not a match for the motor car that has seen service on the road.

Repaint shops have therefore found it economical and profitable to make their own color matches, giving immediate attention to their customers, and yet not have a large stock investment in color.

The above information is common knowledge to every repaint shop, and the individual paint shop has been attempting to meet this condition by matching the shades on the repair jobs to the best knowledge that has been available up to this time.

In spite of this careful work, every one is familiar with the unsatisfactory jobs that come back after several weeks or months, showing fading, change of shade, or in some other way an unsatisfactory condition.

So here are some definite and simple rules for color mixing that will aid the shop craftsman in obtaining the colors that are necessary.

To begin with, it must be recognized that all colors are only relatively permanent. There are no colors that can be considered absolutely fast; therefore the auto painter must know which colors are most permanent and exactly where and when he may use the brighter, but less permanent shades.

There are many ways for arriving at the same shade or tone of color, yet it is highly important that the shop craftsman select the best method, having in mind the ease of color matching, but also considering the permanency of the results obtained.

Color in itself is a comprehensive study, inasmuch as it embraces all tints, shades, strengths and their variations. Technically, black is the absence of color and white the combination of all colors. A shade is oftentimes referred to as a color containing black, and a tint as a color containing some white. Were we to follow this rule exactly, a shade would represent such colors as olive green, plum, scarlet, etc. Straight tints would be such colors as pink, ivory, straw, etc. However, there are many colors that contain both black and white. Hue is supposed to designate the predominating color, which would be red in a pink color. Black and white mixed together produce gray, which is known as a neutral color. Gray serves to blend or harmonize color combinations. Harmonizing color combinations are those that contain a common color. Contrasting colors contain no common color.

Black of course darkens a color and white lightens. Black tends to dull a shade, while the addition of white dilutes the tint.

Each and every color in the Opex Mixing Line has a definite purpose. It must be definitely understood that not all colors are entirely fast under all conditions, and give good coverage. All of the good properties that are essential must be obtained by the proper use of the pigments, each doing its part in certain types of blends and mixes, and if one follows the rules that are laid out in the following pages he will be nearer correct in this refinishing work than he has ever been before.

The use of these 13 base colors, with black and white, make it possible to obtain a very complete range of shades, practically all the automobile finisher will ever be called upon to manufacture. It allows the shop to operate with a minimum of colors in stock. The Opex Mixing Line are standardized colors, always attaining the same color strength, coverage, and other necessary properties. Similar results cannot be obtained by using similar colors from other manufacturers, as the tinting value will not be parallel due to the difference in the balance of pigment and binder.

We consider it highly essential that every shop develop on its staff a shader, or color mixer.

Color mixing is not a difficult art to master, provided one has:

(*a*) Proper mixing enamels.
(*b*) Proper equipment.
(*c*) A fair sense of color technique.
(*d*) A knowledge of the fundamentals of color mixing.

We cannot stress too strongly the following essentials to insure obtaining the best results:

1. Use only clean containers and stirring paddles. Unclean equipment is almost certain to spoil the desired effect.
2. Stir each mixing enamel thoroughly before using; and keep stirring your mixtures constantly. Do not permit the mixture to stand in the spray pot without complete agitation before application.
3. Keep cans tightly closed when not in use. The evaporation of the volatile solvents will affect the tinting strength of the color.
4. Do not match colors under artificial light; use daylight only—preferably sunlight or northern exposure.
5. Unless you are reasonably sure of amounts required, start with very small batches.
6. Start with most predominating colors.

7. Be sure colors are thoroughly dry before making comparison. Almost all shades darken on drying.

8. Do not expect to match a polished finish with an unpolished finish.

9. Usually the larger proportion of the formula will produce the desired depth of color, but will need further toning to bring out the particular character of the shade being matched. This toning often requires too small a quantity to be measured out for small batches. For instance a "touch" of red may mean a small quantity of color on the end of a mixing knife added to a quart batch. The "touch" should always be added as the last ingredient.

10. When comparing samples, remember that the larger the exposed surface, the lighter the color will appear due to light reflection. Therefore, a small color plate should be checked against an area of approximately the same size.

11. Colors should always be mixed *full strength* and reduced to proper spraying consistency with required Opex Thinner when the desired color has been obtained.

12. Excepting reds, maroons and dark blues, white is generally the base of almost all other colors.

13. Yellow, green, red, and orange impart brightness to a mixture.

14. Light colors make objects appear larger and dark colors make things look smaller.

15. From a sales standpoint it is interesting to know that, generally speaking, men prefer the cooler colors, as blues and greens, whereas women have a decided preference for the warmer colors, such as yellows and reds.

16. In the final analysis, however, we in the creation and use of color for motor car refinishing are more concerned with practical automotive painting practice combining proper combination of color and obtaining the best results possible in durability.

Generally, it is true that the brighter and cleaner shades are not as fast to light in small quantities, when let down with white as the duller earth colors. The true test of fastness and durability of color comes when it is let down or mixed with other pigments. A color may be relatively fast when used as a self-color, and not mixed with any other enamels, but that same color, if mixed with other enamels, and used as a tinting shade in relatively small amounts, may be quite fugitive and unsatisfactory. For example, toluidine red, known as one of the fastest of permanent colors in the color varnish industry, has obtained its reputation only because as a self color it is entirely satisfactory. When let down with 20 parts of white the color is really relatively fugitive and not at all satisfactory. Furthermore, toluidine red (Opex Orinoco Vermilion) bleeds in a pyroxylin lacquer vehicle. Para red (Opex Mephisto Red) has similar characteristics. Therefore, we do not recommend their use as mixing enamels. However, they do serve as very durable attractive trim colors when used straight, as is evidenced in their widespread use.

Each and every one of the Opex Mixing Enamels is non-bleeding in lacquer solvents, and can be striped over or finished over without any possibility of bleeding through.

Thus you can understand that it is highly important that the shop man should have an exact knowledge of the individual qualities and characteristics of each and every pigment which he is using, in order to obtain the best possible results in making up the color matches which he is called upon to produce.

With the thought that the consuming trade would like to know more about the goods they are using, the characteristics of the pigments that are incorporated into Opex Mixing Enamels are here given by Sherwin-Williams.

ULTRAMARINE BLUE

Ultramarine blue, which is one of the most permanent and beautiful of pigments, was formerly obtained exclusively from the rare and costly mineral, lapis lazuli. For many years now it has been made synthetically from clay sodium carbonate, sodium sulphate, charcoal, silica, and sulphur. Both the full and reduced shades are bright and clean, and have excellent permanence to light. The tinting or color strength is relatively low, compared to Prussian blue as is also the opacity or covering.

PRUSSIAN BLUE

Prussian blue, also known as iron blue, is a synthetic pigment made from prussiate of soda, or potash, ferrous sulphate, and an oxidizing agent, such as chlorate of potash or bichromate of soda. The full shade is much deeper than that of ultramarine blue, while the tint when reduced with white pigments is a true blue and not a violet. The tinting strength and opacity are both much greater than for ultramarine. The permanence to light of full strength colors is very good, although not equal to ultramarine. In reduced shades, Prussian blue is very fugitive.

LEMON YELLOW—CHROME YELLOW

The pigments used in these enamels are light chrome yellow and medium chrome yellow respectively. They are lead chromate pigments prepared from acetate of lead and sodium bicarbonate. The medium shade is normal or 100 per cent chromate of lead, while the light shade contains approximately 25 per cent of co-precipitated lead sulphate and 75 per cent lead chromate. Both are very bright with good opacity and permanence in full shade. The reduced shades and tints, however, are quite readily affected by the action of sunlight. They do not fade out, but instead turn dark blue, due to a breaking down of the lead chromate. This tendency can be controlled to a considerable extent during the manufacture of chrome yellows. The colors used in both the lemon and chrome shades have much better resistance to light than many of the chrome yellows found on the market.

PERMANENT TONING YELLOW

The yellow which is used for this shade is an artificial iron oxide pigment prepared by precipitating ferrous sulphate with milk of lime or an alkaline hydroxide. The resultant precipitate is then dried and calcined, thus producing a synthetic pigment which approximates the natural raw siennas. The shade, however, is brighter than the earth colors and the tinting strength about three times as great. The permanence to light of both full and reduced shades is excellent.

LIGHT CHROME GREEN—DARK CHROME GREEN

Chrome greens are mixtures of chrome yellow and Prussian blue, generally put together before drying. The brightness of shade, opacity, permanence, and other properties of both pigments are thus combined. The depth of shade is determined by the ratio of blue to yellow, that is, a light shade green contains a low percentage of blue and a high percentage of yellow, while a dark shade green is high in blue and low in yellow. In order to produce a bright clean chrome green it is necessary to use a light chrome yellow since a medium chrome yellow, due to its redder shade, makes a duller or olive type of green. Inasmuch as the tints of chrome yellows and Prussian blue are not fast to light, it follows that the tints on chrome greens made from them are also fugitive. Similarly, it also follows that the full shades have relatively good permanence and cover well.

UMBER

Umber is a natural brown earth color found in many localities. The pigment used in this case comes from Turkey, and is known as raw Turkey umber. Its color is due to the oxides of manganese and iron which it contains. The shade of this type of color is not especially clean, but it has some very desirable properties, in that it is especially fast to light, both full shade and as tints, and has very good opacity.

CRIMSON RED

The pigment used in this enamel is an artificial inorganic color, which is a mixture of cadmium sulphide and cadmium selenide. The shade is relatively bright, and the resistance to light and weathering action is excellent. The reduced shades and tints have good permanence, but are not as fast to light as iron oxide red and sienna. The oil absorption is low, which permits the use of a high percentage of pigment, thus providing very good covering. Cadmium red is absolutely non-bleeding.

OXIDE RED

The color used here is a natural iron oxide red, containing over 90 per cent of ferric oxide. As is the case with most inorganic earth pigments, the fastness to light and opacity are excellent. The shade is especially bright for this type of pigment. It does not, however, approach the brightness of shade of cadmium red.

SIENNAS

Siennas are natural earth colors closely related to the ochres and umbers. They differ from the ochres in that the iron oxide content is higher, running about 40 per cent as compared to 5 to 15 per cent. Like both the ochres and umbers, they are found in many locations, those from Italy being especially desirable. They are not only used in the raw state, but are calcined or heated, being then called burnt siennas. The pigment used in this case is known as Italian burnt sienna and is of this latter type. Similarly to the other earth colors, it is very fast to light, both full shade and reduced, and has good covering. It is also non-bleeding in lacquer solvents.

CHROME ORANGE

Chrome orange is an artificial inorganic pigment very closely related to chrome yellows, since it is a basic chromate of lead prepared from the same raw materials, namely, acetate of lead and sodium bichromate. By the use of higher temperatures and alkalies, a pigment composed of lead chromate and hydrate is obtained. The shade is especially bright and the permanence to light of the full strength and partially reduced color is very good, being even better than full strength chrome yellows. As in the case of chrome yellows, chrome orange has excellent covering power or opacity.

TONING MAROON

The pigment used in this shade is a synthetic organic dyestuff made from hydroxy naphthalene sulphonic acid. It has a bright rich shade, and is very fast to light. Its tinting strength is high and the tint very clean. Unfortunately, the reduced shades are only moderately permanent, making the color unsuitable for use in weak tints. The opacity or covering power is good, and the color is absolutely non-bleeding in lacquer solvents.

BONE BLACK

Bone black is a carbon pigment obtained from the destructive distillation of bones, that is, by heating up bones in the absence of sufficient air for complete combustion. The percentage of carbon in bone black is relatively low, amounting to only 12 to 20 per cent. Bone black is distinguished from other carbon blacks by its content of calcium phosphate. Also the shade is not as jet as lamp black or ordinary carbon black. It is, however, particularly suited as a pigment for mixing with other colors, since it is heavier in gravity, and therefore does not tend to float or separate as much as other blacks. It contains no soluble dyes and is non-bleeding in lacquer solvents. Bone black should not, however, be used straight as a body color, but only for shading.

WHITE

The pigments used in auto white are titanium oxide and zinc oxide.

Titanium oxide is a relatively new pigment obtained from sands which are high in titanium. This finely ground sand is dissolved in sulphuric acid, from which solution the titanium is precipitated in the form of meta-titanic acid, leaving the impurities dissolved in the solution. This meta-titanic acid is dried, calcined and finely ground to produce titanium oxide, which has greater opacity than any other white pigment. Heat and light have no action on it. Also it is not affected by acids or alkalies. The films of paints and lacquers made with titanium oxide alone are not very durable, but this property can be overcome by the introduction of other pigments.

In this case, zinc oxide has been used. This is one of the best known white pigments and has been used satisfactorily for many years. It is produced by vaporizing slabs of zinc metal in a furnace and then burning the zinc vapors by letting them come in contact with oxygen in the air. The pigment thus obtained is known as French Process zinc oxide. It has a very fine particle size and good opacity. By combining these two fine white pigments, an especially desirable blend is obtained, possessing unexcelled covering capacity and opacity.

We will now discuss the use of these pigments when made into enamels and show how the rules regarding their use apply in producing the various shades. Blues will be discussed first, followed by yellows, greens, reds, oranges, maroons and blacks in the order named.

BLUE ENAMELS

The two blues in the Opex Mixing Enamel line, ultramarine and Prussian, are both very valuable and necessary pigments for color mixing and blending. It is the purpose of this handbook to point out definitely the advantages and uses of each. This will enable the craftsman to eliminate some of the troubles resulting from the improper use of these two base colors, and to get full value out of his colors.

In order to make the explanation as simple as possible, it is considered advisable to discuss the subject under three separate groups, as follows:

Group 1—Enamels in which only a small amount of blue is required to produce the shades (less than approximately 10 per cent).

In matching a shade where only a very small amount of blue is required (less than 10 per cent of the total volume), the rule is to always use ultramarine blue for best light fastness. A small amount of Prussian blue, especially in light shades, fades easily in the sunlight, while ultramarine blue is quite fast.

Group 2—Enamels which are entirely or very largely made up of blue (approximately 50 per cent of the total mix).

In deciding on the proper blue to use when a straight dark blue shade is required, the rule is to always use Prussian blue, and never use ultramarine blue. There are three reasons why ultramarine should not be used as a straight or self color.

First, ultramarine does not take a good polish and "clean up" easily. This is an inherent quality of the pigment. Prussian blue, on the other hand, polishes easily.

Second, ultramarine is transparent and has poor covering, which requires extra coats to get the same opacity or covering as with fewer coats of Prussian blue.

Third, ultramarine blue is not durable as compared to Prussian blue when used straight.

The unalterable rule, then, for a straight color for body work, is to always use Prussian blue, which, of course, can be shaded over to any desirable dark blue tone.

When ultramarine blue is blended with other enamels, it of course shows this property of poor polishing to a lesser degree and in proportion to the amount used. It, however, should not be used in large amounts, and it is necessary to place a limit on the amount which can be used with safety. A maximum of 50 per cent is considered a safe limit. Prussian blue then should always be used in blends where blue constitutes approximately 50 per cent of the blend.

Group 3—Enamels which require considerable blue, but not as much as in Group 2 (approximately 10 per cent to 50 per cent).

In matching a shade where between 10 per cent and 50 per cent of blue is required to give the proper shade, the rule is that either ultramarine or Prussian may be used. The one which gives the shade with the simplest combination of pigments is of course the preferable one to use.

Ultramarine blue lets down with white to a reddish-toned blue, while Prussian blue lets down with white to a greenish-toned blue. In the presence of other pigments, such as bone black, umber, etc., these tones are not as pronounced but still must be regarded in mixing. Experience in color mixing is, of course, of value here in knowing just which pigment to use.

From the above information it can be seen that a general statement covering the rules of using ultramarine and Prussian blues would be about as follows:

1. Use ultramarine where a very small amount of blue is required.
2. Use Prussian where a high percentage of blue is required.
3. Use either ultramarine, Prussian, or both where a medium quantity is required.

It must not be forgotten here that chrome green contains Prussian blue and this must be taken into consideration when chrome green is included in the formula. Dark chrome green contains approximately 50 per cent Prussian blue and light chrome green approximately 10 per cent Prussian blue.

YELLOW ENAMELS

There are three yellows in the Opex Mixing Enamel Line: lemon, chrome yellow and permanent toning yellow. It is very important that it be properly understood just where and when each of these should be used in an enamel for best results.

Lemon and chrome yellow are very similar in composition and properties, and the following statements apply to both of these colors:

1. Very good opacity and durability.
2. Very fast to light when used in large amounts (over approximately 40 per cent) and moderately fast when used in smaller amounts (down to 8 or 10 per cent). Readily affected by sunlight (turning dark) when used in very small amounts and tints (under approximately 8 per cent).
3. Clean and bright in color when let down with white.

Permanent Toning Yellow is of a different nature. In comparison to the above its outstanding characteristics are as follows:

1. Very good opacity and durability.
2. Fast to light when used in any amount.
3. Not as clean and bright as chrome yellow when let down with white but cleaner than raw sienna.

From the above statements it can be seen that all three of these yellows are durable and have very good covering, but on account of limited light fastness when let down with whites or other colors, certain restrictions must be placed on the use of lemon and chrome yellow. The following rules should be observed:

1. Where a large percentage of yellow is required in a formula, any of the three yellows may be used, depending upon the shade desired.
2. Where a smaller percentage or touch of yellow is required, permanent toning yellow should be used.
3. In certain cases, where very clean tints, such as clean ivories, are required, it is permissible to use a mixture of permanent toning yellow and lemon or chrome yellow. There are exceptional cases where the resulting shade is too clean to allow any permanent toning yellow and in these instances lemon or chrome yellow alone must be used. It must be understood, however, that the resulting shade is not as fast to light as if only permanent toning yellow were used.

Chrome yellow is also contained in chrome green and this must be taken into consideration when chrome green is included in the formula. Dark chrome green contains approximately 50 per cent chrome yellow and light chrome green approximately 90 per cent chrome yellow.

GREEN AND UMBER ENAMELS

The finisher has at his disposal two green mixing enamels, light chrome green and dark chrome green. He is also able to produce greens with the aid of blues and yellows. It is very necessary that the master painter thoroughly understand when he should use a mixture of yellow and blue to produce a green and when he should use a green to obtain certain shades.

The light and dark chrome greens, like the chrome yellows, are very similar in composition and properties and have the following characteristics:

1. Very good opacity and durability.
2. Fast to light when used in large amounts only.
3. Clean and bright color when let down with white.

Light and dark chrome green are only fast to light when used in relatively large amounts, and therefore it is advisable to use a mixture of ultramarine blue and toning yellow when a small amount of green is required to obtain the shade that is being mixed.

Umber contains a very permanent pigment and may be used wherever possible. However, unlike the chrome green, it does not give a clean shade, and generally is only used in mixing shades of olive green. The following characteristics apply:

1. Very good opacity and durability.
2. Fast to light when used in any amount.
3. When let down with white gives a dirty greenish shade.

In matching a shade where green is required, the craftsman should always adhere to the following rules:

1. Where a large percentage of green is required use either light or dark chrome green for a clean, bright shade.
2. Where a small percentage of green is required, a mix-

ture of ultramarine blue and yellow should be used (wherever possible using permanent toning yellow).

3. In matching olive greens and other shades not clean in tone, where a small amount of green is required, a very permanent shade is produced by using umber.

Note: It is not recommended to use umber in amounts over 50 per cent on account of the poor polishing characteristics of this pigment.

RED ENAMELS

The two reds in the Opex Mixing Enamel Line are: crimson red, oxide red.

In the same classification we can, for convenience in the discussion, include: chrome orange, sienna.

The finisher will save himself much trouble and labor by knowing the characteristics of these particular pigments.

Opex crimson red contains a non-bleeding pigment which is very permanent to light where used straight or as a self color, and even when used as a tinting color gives quite a permanent shade. It is also very clean and bright in tone. Like crimson red, Opex chrome orange has very similar characteristics and properties. They may be summed up as follows:

1. Non-bleeding.
2. Bright in color.
3. Very fast to light when used in large amounts and moderately fast to light when used in small amounts.
4. Very good opacity.

Oxide red and sienna are very similar to each other in properties. However, they distinctly differ from the crimson red and orange in that the pigments used in these enamels are "earth colors" and are very fast to light when used in any amount for blending, which means that oxide red and sienna mixing enamels should be used for tinting when a small amount of red is required.

Oxide red and sienna have the following general characteristics:

1. Brownish red in tone (not bright like crimson red).
2. Non-bleeding.
3. Very fast to light when used in any amount.
4. Very good opacity.

While comparing the qualities of the earth colors, i.e., oxide red and sienna, with the characteristics of the bright synthetic colors, crimson red and orange, it can be appreciated that the following rules must be observed to obtain shades that will not quickly fade when exposed to the ultraviolet rays of the sun:

1. Where a large percentage of red is required, use any of the reds or orange in the Opex Mixing Enamel line, as they are all fast to light when used in large amounts.
2. Where a small percentage of red or orange is required, use either oxide red or sienna because both these base colors are very fast to light when used in any amounts. In special cases where the shade does not permit oxide red or sienna, there is no alternative but to use orange or crimson red.

MAROON ENAMELS

Opex toning maroon is very rich in tone, and contains a pigment that, due to this quality, does not have quite as good opacity as some other pigments when used as a straight color. Nevertheless, it can be employed as a self color, preferably over a suitable ground coat, or body color, where desired, and will be found to chalk less on exposure than is generally common with other maroon lacquer enamels.

Opex toning maroon also enjoys the distinction of being non-bleeding.

The following characteristics apply:

1. Rich in tone.
2. Non-bleeding.
3. Moderately fast to light when used in large amounts and quite readily affected by sunlight when used in very small amounts.
4. Good opacity.

BLACK ENAMELS

Bone black contains a pigment that is essential for a shading color, as it does not float like lamp black or carbon black. It is not a jet black, but rather a grayish brown black, therefore it should not be used as a straight color. Like oxide red and sienna, Opex bone black is an earth pigment and is very permanent to light when used for shading in any amount. A jet black is not necessary for a mixing enamel, as it is only used for shading and should not be used as an all-over body finishing coating. Bone black is also non-bleeding, and does not contain any dyes which not only cause bleeding but are very fugitive upon direct exposure to the ultra-violet sun rays.

GLOSSARY OF TERMS

Opacity—The meaning of the word "opacity" is interpreted as follows:

An opaque film is a film that light cannot easily pass through and is therefore the opposite to transparent. When a lacquer film has good opacity, it means that this film will have good "hiding" or "covering" properties.

Note: The more opaque a lacquer film is, the better it will stand up to the ultraviolet rays of the sun.

Light Fastness—The phrase "light-fastness" or "fast to light" applies to a non-fading color or a color that when exposed to the ultra-violet rays of the sun will not fade out.

Let Down—When a color is "let-down" it is "extended" or "diluted" with the addition of white. For example, a pink or a cream shade would be made by "letting down" a red or a yellow as the case may be.

Non-Bleeding—The term "non-bleeding" in this book is used to indicate that the lacquer or pigment referred to does not penetrate through the next coat when another color is sprayed over it.

For Example: When white is applied over red, and the red comes up in the white making it pink, the red is said to be "bleeding."

Tone—Over Tone, Top Tone, and Mass Tone refer to the appearance of a full strength color by reflected light.

Tinting Strength—Tinting Strength is the ability of a color to predominate when mixed with another color.

Fugitive—Fugitive refers to the lack of stability of a color when exposed to sunlight.

Floating—Floating in a film refers to the separation of pigments of different specific gravities, whereby the lighter one comes to the surface.

Viscosity—Viscosity refers to Body, Fluidity, Consistency of the liquids.

Volatile—Evaporating at ordinary temperatures on exposure to air.

Lacquer Enamel—This term distinguishes the finishing or color coats from the undercoatings.

Undercoatings—The primary or surfacing coats.

Mist Coat—A finely atomized spray resulting in a very light coat.

Flood Coat—A heavy, full, or wet coat.

Nitrated Cotton—This is sometimes referred to as cellulose nitrate, nitro-cotton, or nitro-cellulose—cotton which is treated with nitric and sulphuric acid, which change its chemical structure so that it will dissolve or be soluble in lacquer solvents. This permits the cotton to be put into a liquid state so it may be sprayed and upon evaporation of the solvents becomes a solid again in the form of a film.

Solid Content—The solids, or the non-volatile portion of a lacquer, which form the final film (nitrated cotton, gum, plasticizer, and pigment) that are incorporated into a lacquer. Their individual characteristics are as follows:

Nitrated Cotton—Hardness, Toughness, Durability.

Gum—Gloss, Adhesion.

Plasticizer—Elasticity or Flexibility.

Pigment—Color and Opacity.

Solvents—Alcohol base liquids that dissolve the nitrated cotton (with the familiar "banana oil" odor), produced in a process of distillation in the fermentation of corn mash (with the active assistance of trained "bugs" or culture). These solvents have a wide range of evaporation—some are very quick dryers; others dry very slowly. The low boilers or quick dryers are cheap in cost, whereas the slow dryers are expensive, and the amount of medium or high boilers employed in the formulation determines both the quality and cost of the solvent mix.

Non-Solvents—Volatile liquids that are distillates of coal tar, petroleum, or ordinary alcohol which are solvents for the gums or resins incorporated into a lacquer. A good formulation must contain a scientifically correct amount of both solvents and non-solvents in order that neither the cotton nor the gum will be precipitated by an unbalanced solvent mixture at the end of drying. The non-solvents are also available in a wide range of evaporation, and therefore their selection has an important bearing upon the flow of the solids in the drying process.

Solvent Mix—A blend of several solvents. There is no one solvent that will efficiently dissolve each of the solids, so the formulator must group a number to obtain complete solubility, keeping results rather than cost foremost in his calculations.

Binder—The nitrated cotton, gum, and plasticizer which serve to hold the pigment together in a tight, impervious film. The percentage of binder to pigment must be carefully proportioned if we are to have a film with sufficient elasticity and not be short or become embrittled prematurely.

Chalking—A disintegration or gradual wearing away of the film. Represents the manner in which a good lacquer or house paint wears away in contrast to the common checking of a varnish film. It is not natural for a good lacquer enamel to check or crack, and when one does it is due to improper application or formulation. Blues and maroons generally chalk sooner than other colors, due to the inherent characteristics of the pigment.

Settling—All pigmented or colored lacquers have a tendency to settle in the bottom of the package, upon standing in stock a long time. That is why we urge that all lacquers be thoroughly stirred before being used; so all the pigment is incorporated with the liquid which contains the binder (nitrated cotton, gum and plasticizer). Otherwise, the lacquer will lack covering or be off-shade. To prevent as far as possible this settling of the pigment, pigmented lacquers or lacquer enamels are put up in a heavy body that must be reduced for spraying. Clear lacquers containing no pigment are, therefore, offered to the trade ready to spray, though they may be formulated to take reduction.

CHAPTER XXXI

REFINISHING COMMERCIAL VEHICLES

Profits from refinishing trucks, delivery cars, and such units make this line of work particularly attractive.

Business men in all lines are realizing more and more each day that their delivery equipment indicates the type of service they render.

Consider the excellent service and cleanliness of some of the large dairies. Invariably their trucks are white—and spotless. Think of the character of service rendered by some of the larger department stores. Again we find equipment that constantly looks new.

A truck is in effect a traveling sign board, and no business can afford to let this advertising suggest anything unfavorable. A man is known by the company he keeps—and a business is known by the appearance of the trucks it keeps.

When it comes to refinishing commercial vehicles there is a big difference in the materials used as compared to those used when refinishing passenger cars. Of course this remark does not apply to those light delivery cars which are, in effect, merely passenger cars with closed sides. It applies to vans with composition sides; to trucks that are of combined wood and steel construction, and to all commercial vehicles that see heavy duty.

To be satisfactory for commercial vehicle duty, a finish must combine flexibility, good appearance, and durability. Furthermore, it must not take too long to apply. Several companies have developed finishes that meet these requirements. The exact manner in which the finish is built up depends to some extent upon the brand used. Each manufacturer supplies explicit instructions covering the application of his own product.

However, as a guide to the procedure used in commercial vehicle refinishing the following from the Du Pont organization is quoted:

I. GENERAL

Du Pont offers their 259 Line Duco, 246 Line Duco and Automotive Dulux for commercial refinishing. The 259 Line Duco is an adaptation of the standard line of Duco, specially formulated to provide the greater flexibility which truck bodies require in a finish. In using any pyroxylin material, however, extensive and careful surface preparation is necessary. This necessarily limits its usage to high class vehicles of sufficient value to warrant the expense.

Automotive Dulux is an entirely new type of finish. It may be used on all classes of vehicles from the finest to the roughest.

Special new undercoating materials for use under Automotive Dulux have been developed from the same basic materials as Automotive Dulux itself, thus providing a complete system of this new line of products.

II. PRODUCTS AND METHODS OF APPLICATION

A. Automotive Dulux Colors

Sec. 1. Automotive Dulux is not a pyroxylin enamel, a varnish enamel or an oil enamel. It is an entirely new product made of new raw materials.

Automotive Dulux comes in the can at spraying consistency. If reducing is necessary, due to evaporation of solvents from open cans, use T-3812 Automotive Dulux Thinner. When held in stock for any considerable length of time, it may skin over in the closed can. This does not spoil the product. The skin should be lifted off and the contents strained to catch any small particles.

In spraying Automotive Dulux, the first coat should be a medium coat. Precaution should be taken not to flow on too heavy a coat.

The second coat may be applied as soon as the first coat has set up sufficiently so that the combined two coats will not sag. This will be in from ½ to 1½ hours after application of the first coat. If for some reason the second coat can not be applied within this time, the first coat should stand for 12 hours. The third coat, if one is necessary, should be applied after overnight or 15 hours' drying of the second coat.

Automotive Dulux is as sensitive to grease and foreign matter as Duco. Make sure the surface is clean.

Automotive Dulux should be applied in a well ventilated room free from draughts. A temperature of 70° F. is desirable.

The dust from spraying Automotive Dulux is wet and it should not be sprayed where the dust may settle on other cars. In spraying a job, start at a corner and work around the job to that corner. Do not start spraying in the middle of a panel.

In touching up Automotive Dulux, cut in spot where finish is broken and lightly spray entire panel.

Before masking, be sure color coat is dry. Overnight is safe.

B. T-3812 Automotive Dulux Thinner

Sec. 2. Use T-3812 Automotive Dulux Thinner to reduce Automotive Dulux colors, except when Automotive Dulux is used for striping. (See Sec. 29.) Also when Automotive Dulux is to be applied over a lacquer finished surface, Duco Thinner, 3601 or 3634 may be added up to 10 per cent to strike into the lacquer and give better adhesion.

C. 98 Line Automotive Dulux (Special Brushing)

Sec. 3. This line is a modification of Automotive Dulux, slower in drying than the 93 Line and, therefore, particularly suited for brush work. It brushes freely on large panels and does not show laps or brush marks.

If thinning is necessary, stir in T-3812 Automotive Dulux Thinner.

The drying time between coats should be about 15 hours.

The final coat should stand 24 hours before the job is put in service.

D. RC-190 Automotive Dulux Exterior Clear

Sec. 4. This product may be used as a clear coat for gloss over Automotive Dulux or 246 or 259 Line Duco, or as a special varnish for decalcomanias. Over a hard drying lacquer, such as 246 Line Duco, failure will occur at an earlier date than over Automotive Dulux or 259 Line Duco. The failure will be in the nature of peeling but will occur at a later date than with orthodox finishing varnishes. It may also be used as a slow size for large decalcomanias where 1950 Combination Size and Pencil Varnish dries too quickly.

This product comes at brushing consistency. For spraying, stir in 10 per cent of Pure Spirits of Turpentine. Strain before using.

Each full coat of RC-190 should stand about 15 hours before another coat is applied. At least two coats with a minimum of 15 hours' dry between coats for finishing new or old work is recommended.

Do not add oil or varnish to this product.

If desired, up to 10 per cent RC-190 Automotive Dulux Exterior Clear may be added to 93 Line Automotive Dulux colors to improve the brushing qualities of the latter or to improve luster when sprayed. Before masking allow 17 to 18 hours for hard dry.

E. 1950 Combination Size and Pencil Varnish

Sec. 5. This product comes at brushing consistency. No thinning is necessary, but should it thicken, due to evaporation, it may be brought back with T-3812 Automotive Dulux Thinner. Under no circumstances should Duco Thinners be added to it. 1950 may be used over 246 Line and 259 Line Duco or Automotive Dulux as a Pencil Varnish. It takes on the proper tack in about 15 minutes for decals and gold leaf, and the penciling in may be done after the leaf or decals have been allowed to stand overnight.

It will not self-lift and dries out-of-tack in about one hour.

In durability it will be found better than the most durable finishing varnish.

1950 is not a pyroxylin product, but is essentially an Automotive Dulux resin solution.

For cleaning up the excess size around decals, benzine should be used, as gasoline has a tendency to lift the edges.

F. 259 Line Duco

Sec. 6. This is a modification of standard Duco, specially designed for use on wood and other porous surfaces where expansion and contraction is greater than in case of metal.

It is shipped at heavy consistency and should be reduced with an equal volume of 3601 or 3634 Duco Thinner. 259 Line Duco is slower drying than 246 Line Duco. It dries with a medium gloss, which may be increased by spraying a mist coat of 3601 Thinner within four hours.

It cannot be compounded, but the gloss may be increased with No. 7 Duco Polish after overnight drying.

All coats of 259 Line should be applied the same day, or lifting is likely to be encountered. If not practical, first coat next day should be fogged on.

In touch-up, spray lightly to avoid lifting.

Before masking, 259 Line should be allowed to dry several hours, or better still, over night, otherwise the tape will mark the Duco.

G. 246 Line Duco (Rubbing and Polishing)

Sec. 7. This is a marked improvement over 244 Line Duco. It is for use on all-metal surfaces. It is shipped at heavy consistency, and, as a rule, all colors should be reduced in the proportion of one and one-half parts Thinner to one part Duco.

III. MISCELLANEOUS INFORMATION

A. Removing Old Finish

Sec. 8. Removers as a rule contain wax. The purpose of the wax is to form a skin which traps the active solvent and holds it in contact with the old finish instead of allowing it to pass off. FV-2061 Blue Diamond Paint and Varnish Remover may be used on metal without much risk. The metal should be washed afterward with high test gasoline or 3907 Solvent. If FV-2061 is used on wood or other porous surfaces it should be followed by a washing with FV-2091 Blue Diamond Waxless Remover for Wood or any Duco Thinner.

The best remover for porous surfaces is a torch as there is no residue or grease left in the pores. The use of a torch entails a certain amount of fire risk and the job should be taken outside the shop when the old finish is stripped.

Start at the top and work down, as by so doing the possibility of the old finish taking fire is minimized.

B. Preparation of Metal

Sec. 9. There seems to be a tendency on the part of refinishers to get away from the well-established procedure of sanding metal before priming. This has been brought about by the fact that the auto body being used today is a big improvement over that in use several years ago as it is much smoother and contains very few marks. When cars were finished in varnish the metal was rough and a great amount of filing was done. The filing not only evened up the surface but the etching enabled the primer to form a good bond with the metal. We strongly recommend that metal be sanded before priming, preferably with a rust remover. In this way two results are accomplished: rust is removed, the metal is etched and actually rust resistance is improved. As a matter of fact, it is good practice to sand and dry surface before applying a new coat. When metal is prepared for priming the primer should be applied at once. Do not let the metal stand without primer as rusting starts immediately and sufficient will take place in 10 to 15 hours to seriously affect adhesion.

C. Galvannealed or Galvanized Metal

Sec. 10. This metal should be prepared for priming by brushing on a solution of one pound of copper sulphate crystals dissolved in a gallon of water. Upon drying, a black deposit will be noticed which must be removed by a thorough washing with plenty of water. The metal should then be dried with clean rags until no black shows when surface is vigorously rubbed with a white rag. Take necessary precautions that wood parts do not become wet.

D. Blue Annealed Steel

Sec. 11. This metal should be very thoroughly sanded with abrasive or wire brush wet with "Deoxidine," "Rusticide," or similar preparations, followed by a wash with water. F-6199 Primer should be applied immediately following drying.

E. Lamps and Plated Metal

Sec. 12. If not replated, should be sanded with No. 400 abrasive and two coats Automotive Dulux applied.

F. Priming Metal

Sec. 13. F-6199 Blue Diamond Dark Oxide Metal Primer may be brushed or sprayed. A light coat is recommended. Overnight to 24 hours should be allowed for drying.

2331538 Pyroxylin Primer is not recommended for use in refinishing burn-off jobs or new jobs, as too much care is required to secure absolutely clean metal. Its use, therefore, should be confined to touch-up work or as a sealer over old surfaces finished with hard drying lacquer. It is shipped at spraying consistency.

Never use Automotive Dulux over Pyroxylin Primer direct.

G. Priming Wood and Composition Panels

Sec. 14. New wood or new composition panels (Vehisote, etc.) require a Wood Primer to satisfy the suction of the pores. For this purpose use F-6402 Gray Wood Primer. Brush one coat on wood parts and allow about 15 minutes to partially dry. Then wipe off surplus with clean rag. Immediately apply coat of F-6199 Blue Diamond Dark Oxide

Metal Primer. Allow overnight to 24 hours for drying. Do not apply F-6402 to metal parts.

H. Priming (First Coat) over Old Finish on Wood and Metal Surfaces

Sec. 15. On wood or metal surfaces where the smoothness of the surface is not of first importance, but where adhesion and flexibility are important—such as all chassis, stake and express bodies, neck yokes, wagonshafts, etc.—use F-7622 Gray Oil Primer. Spray or brush one coat and allow 12 to 15 hours for drying.

I. Glazing

Sec. 16. Immediately before glazing, fill nail holes, etc., with FP-4090 Gray Hard Putty. For a full glazing coat on wood use FP-4095 Gray Glazing Putty. This is necessary on open grain wood and composition panels (Vehisote, etc.) and on close grain wood when surface is badly marked. Dry both putties together for 15 to 24 hours.

Sec. 17. For spot putty work over DUX Surfacer—due to imperfections that DUX Surfacers have not filled—glaze marks with DUX Glazing Putty (color to be selected) after DUX Surfacer has dried from two to four hours. (This putty, specially formulated as a part of the Dulux system, is offered in four colors: DUX 1902 Gray; DUX 1903 White; DUX 2102 Light Red; DUX 2100 Maroon. These correspond to the colors in which DUX Surfacers are offered.)

If nail holes still show, immediately fill with DUX 1901 Gray Hard Putty. Allow 12 to 15 hours for drying.

Sec. 18. If Flexible Pyroxylin Surfacer or Pyroxylin Surfacer is used, spot glaze any marks with 2281031 Gray PX Glazing Putty after surfacer has dried one hour.

J. Surfacing

1. DUX Surfacers

Sec. 19. This new line of Surfacers is as different from oil and pyroxylin surfacers as Automotive Dulux is different from paint and lacquers. They are suitable for use under either 259 Line Duco or Automotive Dulux.

The surfacers come at brushing consistency and should be reduced with T-3812 Automotive Dulux Thinner for spraying. When sprayed, allow each coat to flat off before applying another coat—about 15 minutes. When brushed, allow each coat to stand at least four hours before brushing another coat.

When DUX Surfacers are to be applied over lacquer surfaces, a thorough cleaning and sanding of the surface is recommended, followed by a mist coat of 3601 or 3634 Duco Thinner. The DUX Surfacers may be reduced up to 10 per cent with Duco Thinner to strike into the lacquer and give better adhesion, otherwise procedure is as described above.

These surfacers may be sanded dry with No. 280 or No. 320 Paper. If water sanding is preferred make sure the surface is hard dry. Overnight drying should be allowed before sanding.

DUX Surfacers are supplied in four colors in order that a shade corresponding to the color coat may be selected, thereby eliminating a ground coat. These colors are: DUX 2304 Gray; DUX 2306 White; DUX 2307 Light Red; DUX 2310 Maroon. The different surfacers may be mixed together to obtain intermediate shades.

2. Flexible Pyroxylin Surfacers.

Sec. 20. In applying 259 Line Duco over old lacquer touch up spots with Flexible Pyroxylin Surfacer (2331567 Dark Gray; 2334441 Light Gray; 2334442 White), reduced in the proportion of one gallon of Surfacer to a half gallon or more of Duco Thinner. Then spray two or more coats on the entire body. The coats may be applied one after another without waiting. Wet sand with No. 280 or No. 320 paper after about three hours' drying.

3. Pyroxylin Surfacers

Sec. 21. On all-metal jobs where 246 Line Duco is to be used, 2331029 Dark Gray, 2331035 Light Gray or 2334274

White Pyroxylin Surfacer are recommended. Successive coats may be applied without waiting. The final coat should stand about 3 hours before being rubbed with No. 280 or No. 320 abrasive paper and water. They should be reduced in proportion of one gallon Surfacer to one-half gallon or more of Duco Thinner.

For touch-up work 2337886 Hi-Speed Pyroxylin Primer-Surfacer may be used. This product reduces in proportion of one gallon Primer-Surfacer to one-half gallon or more of Duco Thinner. It should be rubbed out with No. 320 abrasive and high-test gasoline in about 30 minutes.

K. Chassis Finishing

Sec. 22. Because chassis finishing is a standard procedure it is possible to give one set of general specifications covering this work.

Operation No. 1. Clean chassis free from grease and oil. This may be done with steam or a wash with high-test gasoline.

Operation No. 2. Sand.

Operation No. 3. Spray or brush one coat F-7622 Gray Oil Primer and allow 12 to 15 hours for drying. (See Sec. 15.)

Operation No. 4. Spray or brush two or more coats Automotive Dulux. (See Sec. 1.)

L. Wheel Finishing

Sec. 23. Because wheel finishing is a standard procedure it is possible to give one set of general specifications covering this work.

A. Wood Wheels.

Operation No. 1. Clean wheels free from grease and oil. This may be done with steam or a wash with high-test gasoline.

Operation No. 2. Sand.

Operation No. 3. Spray or brush one coat F-7622 Gray Oil Primer and allow 12 to 15 hours for drying. (See Sec. 15.)

Operation No. 4. Spray or brush two or more coats of Automotive Dulux. (See Sec. 1.)

B. Wire Wheels.

Operation No. 1. Clean wheels free from grease and oil. This may be done preferably by sand blasting or with steam or a wash with high-test gasoline. If rusty, sand or wire brush to remove rust.

Operation No. 2. Spray one coat F-6199 Blue Diamond Dark Oxide Metal Primer and allow overnight to 24 hours for drying. (See Sec. 13.)

Operation No. 3. Spray two or more coats of Automotive Dulux. (See Sec. 1.)

M. Fender and Splash Apron Finishing
(Baked Enamel or Lacquer)

Sec. 24. Because Fender and Splash Apron Finishing is a standard procedure, it is possible to give one set of general specifications covering this work.

Operation No. 1. Clean free from grease and oil and rust.

Operation No. 2. Sand.

Operation No. 3. Spray or brush one coat F-6199 Blue Diamond Dark Oxide Metal Primer and allow overnight to 24 hours for drying. (See Sec. 13.) If film is not broken and if the surface is carefully cleaned free from all traces of wax, polish, or grease and thoroughly sanded, this operation may be omitted.

Operation No. 4. Spray or brush two or more coats of Automotive Dulux. (See Sec. 1.)

N. Interior of Body Finishing

Sec. 25. Because Interior of Body Finishing is a standard procedure it is possible to give one set of general specifications covering this work.

Operation No. 1. Clean free from grease and oil.

Operation No. 2. Spray or brush two coats Automotive Dulux. (See Sec. 1.)

O. Top Dressing

Sec. 26. Because Top Dressing is a standard procedure it is possible to give one set of general specifications covering this work.

Operation No. 1. Clean with gasoline and allow to dry. Do not use soap and water.

Operation No. 2. Brush two coats No. 7 Auto Top Finish allowing 12 hours between coats.

P. Gold Leaf

Sec. 27. Pounce surface with powdered whiting and outline letters. Fill in letters with RC-190 Automotive Dulux Exterior Clear or 1950 Combination Size and Pencil Varnish and allow to become tacky. Apply Gold Leaf to Size and pat down with cotton dipped in talcum powder. Allow to stand about one hour and wipe off excess gold leaf, etc. Follow after overnight drying, with either RC-190 Automotive Dulux Exterior Clear or 1950 Combination Size and Pencil Varnish. (See Sec. 4 and 5 for further information.)

Q. Decalcomanias

Sec. 28. Use 1950 Combination Size and Pencil Varnish as size for small decals and RC-190 Automotive Dulux Exterior Clear as size for large decals. RC-190 or 1950 may be used as protective coating. (See Sec. 4 and 5 for further information.)

Follow instructions issued by manufacturers of decals.

R. Striping and Lettering

Sec. 29. Automotive Dulux will be found satisfactory for striping on Automotive Dulux. The addition of a small amount of RC-190 Automotive Dulux Exterior Clear and 3601 Thinner is advisable. The Clear will make the stripe pull out easier and the Thinner will cause the stripe to bond better with the body colors.

210 Line Striping colors should be used on 259 and 246 Line colors.

S. Moldings and Joints

Sec. 30. Applied moldings and joints should be cut to prevent bridging. About a half hour after application of surfacer, joints should be cut with a putty knife. If bridging takes place with the first color coat, it should be cut. The last color coat should not be cut. To avoid bridging of last coat, add Thinner.

T. Thinning

Sec. 31. In adding Thinner to a refinishing product always stir it in slowly. Do not dump it all in at once.

U. Stirring

Sec. 32. All products containing pigments should be stirred thoroughly from the bottom of the can with a flat paddle until the pigment has been incorporated with the vehicle.

V. Cleaning Brushes and Spraying Equipment

Sec. 33. Automotive Dulux Thinner will not soften Automotive Dulux after it becomes hard. For this reason Thinners for Duco should be used for cleaning spraying equipment and brushes. Brushes should be cleaned immediately as Automotive Dulux will harden in the heel and make them "lousy." After using a brush in Automotive Dulux do not place it in a keeper as Automotive Dulux will harden when immersed in oil and become contaminated. Wash the brush out thoroughly, making sure that it is clean, then wrap it in paper and lay it flat.

SPECIFICATION "A"

Automotive Dulux on New Bodies (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, Etc.).

BODY

Operation No. 1. Brush one coat F-6402 Gray Wood Primer on wood parts and allow about 15 minutes to partially dry. Then wipe off surplus with clean rag. Immediately apply coat of F-6199 Blue Diamond Dark Oxide Metal Primer to both wood and metal parts. Allow 15 to 24 hours for drying. Do not apply F-6402 to metal parts. (See Sec. 13 and 14.)

Operation No. 2. Fill nail holes with FP-4090 Gray Hard Putty. Immediately glaze with FP-4095 Gray Glazing Putty. Dry 15 to 24 hours. (See Sec. 16.) This operation may be omitted if desired.

Operation No. 3. Spray or brush two or more coats DUX Surfacer. Allow 15 minutes between coats when spraying, four hours between coats when brushing. (See Sec. 19.)

Operation No. 4. After two to four hours' drying glaze, if necessary, with DUX Glazing Putty (Color to be selected). Fill nail holes with DUX 1901 Gray Hard Putty. Dry 12 to 15 hours. (See Sec. 17.)

Operation No. 5. Sand dry. If water sanding is preferred make sure surfacer and putty are hard dry. Clean up and dry thoroughly.

Operation No. 6. Spray two or more coats of Automotive Dulux. (See Sec. 1.)

Operation No. 7. Striping. (See Sec. 29.)

Operation No. 8. Decalcomanias. (See Sec. 28.)

Operation No. 9. Pencil decalcomanias or brush or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 22.)

WHEELS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 23.)

HOOD, CAB, FENDER AND SPLASH APRONS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

Tops of new bodies do not require finishing.

Automotive Dulux on "Burn-Off" Jobs (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, etc.).

BODY AND HOOD

Operation No. 1. Burn off old finish with torch or FV-2061 Blue Diamond Paint and Varnish Remover. (See Sec. 8.)

Operation No. 2. Brush one coat F-6402 Gray Wood Primer on wood parts and allow about 15 minutes to partially dry. Then wipe off surplus with clean rag. Immediately apply coat of F-6199 Blue Diamond Dark Oxide Metal Primer to both wood and metal parts. Allow 15 to 24 hours for drying. Do not apply F-6402 to metal parts. (See Sec. 13 and 14.)

Operation No. 3. Fill nail holes with FP-4090 Gray Hard Putty. Immediately glaze with FP-4095 Gray Glazing Putty. Allow 15 to 24 hours for drying. (See Sec. 16.) This operation may be omitted if desired.

Operation No. 4. Spray or brush two or more coats of DUX Surfacer (color to be selected) on both wood and metal parts. (See Sec. 19.)

Operation No. 5. After two to four hours, glaze, if necessary, with DUX Glazing Putty (color to be selected). Fill nail holes, etc., with DUX 1901 Gray Hard Putty. Allow 12 to 15 hours for drying. (See Sec. 17.)

Operation No. 6. Sand dry. If water sanding is preferred, make sure that surfacer and putty are hard dry. Clean up and dry thoroughly.

Operation No. 7. Spray two or more coats of Automotive Dulux. (See Sec. 1.)

Operation No. 8. Striping. (See Sec. 29.)

Operation No. 9. Decalcomanias. (See Sec. 28.)

Operation No. 10. Pencil decalcomanias or brush or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

SPECIFICATION "C"

Automotive Dulux on new jobs finished with Automotive Dulux or lacquer.

BODY AND HOOD

Operation No. 1. Thoroughly clean and roughen finish by sanding with high-test gasoline, using No. 280 paper. Make sure that all traces of wax, polish and grease are removed.

Operation No. 2. Apply one coat of F-6199 Blue Diamond Dark Oxide Metal Primer. (See Sec. 13.)

Operation No. 3. Spray two or more coats of Automotive Dulux. (See Sec. 1.)

Operation No. 4. Striping. (See Sec. 29.)

Operation No. 5. Decalcomanias. (See Sec. 28.)

Operation No. 6. Pencil decalcomanias or brush or spray entire job with RC-190 Automotive Dulux. (See Sec. 4.)

CHASSIS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 22.)

WHEELS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 23.)

FENDER AND SPLASH APRONS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

Tops of new bodies do not require finishing.

SPECIFICATION "D"

Automotive Dulux over old Automotive Dulux, paint, enamel or lacquer. (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, etc.).

BODY AND HOOD

Operation No. 1. If old finish is Automotive Dulux, paint or enamel, dry sand thoroughly. If old finish is lacquer, sand thoroughly with high test gasoline. In either case, clean up carefully to remove all foreign matter. Use clean rag for final wipe. Rust spots, where finish has been broken, should be rubbed bright with emery paper and edges of finish "feathered."

Operation No. 2. Apply one coat of F-6199 Blue Diamond Dark Oxide Metal Primer. (See Sec. 13.)

Operation No. 3. Touch up spots with DUX Surfacer (Color to be selected) and spray or brush two or more coats of DUX Surfacer on entire body. (See Sec. 19.)

Operation No. 4. After two to four hours, if necessary, glaze with DUX Glazing Putty (color to be selected). Fill nail holes, etc., with DUX 1901 Gray Hard Putty. Allow 12 to 15 hours for drying. (See Sec. 17.)

Operation No. 5. Sand dry. If water sanding is preferred, make sure the surfacer and putty are hard dry. Clean up and dry thoroughly.

Operation No. 6. Spray two or more coats of Automotive Dulux. (See Sec. 1.)

Operation No. 7. Striping. (See Sec. 29.)

Operation No. 8. Decalcomanias. (See Sec. 28.)

Operation No. 9. Pencil decalcomanias or spray or brush entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

SPECIFICATION "E"

Automotive Dulux on New Wood, Stake and Express Bodies. (This includes Neck Yokes, Wagon Shafts, and any new wood where surface is not of first importance and where adhesion and flexibility are.)

BODY

Operation No. 1. Brush one coat F-6402 Gray Wood Primer on wood parts and allow about 15 minutes to partially dry. Then wipe off surplus with clean rag. Immediately apply coat of F-6199 Blue Diamond Dark Oxide Metal Primer to both wood and metal parts. Allow 15 to 24 hours for drying. Do not apply F-6402 to metal parts. (See Sec. 13 and 14.)

Operation No. 2. Spray or brush two or more coats of Automotive Dulux. (See Sec. 1.)

Operation No. 3. Striping. (See Sec. 29.)

Operation No. 4. Decalcomanias. (See Sec. 28.)

Operation No. 5. Pencil decalcomanias or spray or brush entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 22.)

WHEELS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 23.)

HOOD, CAB, FENDERS AND SPLASH APRONS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 24.)

INSIDE OF BODY

(See Sec. 25.)

TOPS

Tops of new bodies do not require finishing.

SPECIFICATION "F"

Automotive Dulux on Used Wood Stakes and Express Bodies. This includes Neck Yokes, Wagon Shafts, and any Used Wood where surface is not of first importance and where adhesion and flexibility are.

BODY AND HOOD

Operation No. 1. Dry sand thoroughly and clean up.

Operation No. 2. Spray or brush one coat F-7622 Gray Oil Primer and allow 12 to 15 hours for drying. (See Sec. 15.)

Operation No. 3. Spray or brush two or more coats of Automotive Dulux. (See Sec. 1.)

Operation No. 4. Striping. (See Sec. 29.)

Operation No. 5. Decalcomanias. (See Sec. 28.)

Operation No. 6. Pencil decalcomanias or spray or brush entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

SPECIFICATION "G"

259 Line Duco on New Work (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, etc.).

BODY AND HOOD

Operation No. 1. Brush one coat F-6402 Gray Wood Primer on wood parts and allow about 15 minutes to partially dry. Then wipe off surplus with clean rag. Immediately apply coat of F-6199 Blue Diamond Dark Oxide Metal Primer to both wood and metal parts. Allow 15 to 24 hours for drying. Do not apply F-6402 to metal parts. (See Secs. 13 and 14.)

Operation No. 2. Fill nail holes, etc., with FP-4090 Gray Hard Putty. Immediately glaze with FP-4095 Gray Glazing Putty. Allow 15 to 24 hours for drying. (See Sec. 16.) This operation may be omitted if desired.

Operation No. 3. Spray or brush two or more coats DUX Surfacer (color to be selected) on both wood and metal parts. (See Sec. 19.)

Operation No. 4. After two to four hours, if necessary, glaze with DUX Glazing Putty. (Color to be selected). Fill nail holes, etc., with DUX 1901 Gray Hard Putty. Allow 12 to 15 hours for drying. (See Sec. 17.)

Operation No. 5. Sand dry. If water sanding is preferred, make sure the surfacer and putty are hard dry. Clean up and dry thoroughly.

Operation No. 6. Spray two or more coats of 259 Line Duco. (See Sec. 6.)

Operation No. 7. Striping. (See Sec. 29.)

Operation No. 8. Decalcomanias. (See Sec. 28.)

Operation No. 9. Pencil decalcomanias with RC-190 or 1950 Combination Size and Pencil Varnish, or brush or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Secs. 4 and 5.)

CHASSIS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 22.)

WHEELS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 23.)

FENDERS AND SPLASH APRONS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

Tops of new bodies do not require finishing.

SPECIFICATION "H"

259 Line Duco on "Burn-Off" Jobs (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, etc.).

BODY AND HOOD

Operation No. 1. Burn off old finish with torch or FV-2061 Blue Diamond Paint and Varnish Remover. (See Sec. 8.)

Operation No. 2. Brush one coat F-6402 Gray Wood Primer on wood parts and allow about 15 minutes to partially dry. Then wipe off surplus with clean rag. Immediately apply coat of F-6199 Blue Diamond Dark Oxide Metal Primer to both wood and metal parts. Allow 15 to 24 hours for drying. Do not apply F-6402 to metal parts. (See Secs. 13 and 14.)

Operation No. 3. Fill nail holes with FP-4090 Gray Hard Putty. Immediately glaze with FP-4095 Gray Glazing Putty. Allow 15 to 24 hours for drying. (See Sec. 16.) This operation may be omitted if desired.

Operation No. 4. Spray or brush two or more coats of DUX Surfacer (color to be selected) on both wood and metal parts. (See Sec. 19.)

Operation No. 5. After two to four hours, if necessary, glaze with DUX Glazing Putty (color to be selected). Fill nail holes, etc., with DUX 1901 Gray Hard Putty. Allow 12 to 15 hours for drying. (See Sec. 17.)

Operation No. 6. Sand dry. If water sanding is preferred, make sure that Surfacer and Putty are hard dry. Clean up and dry thoroughly.

Operation No. 7. Spray two or more coats of 259 Line Duco. (See Sec. 6.)

Operation No. 8. Striping. (See Sec. 29.)

Operation No. 9. Decalcomanias. (See Sec. No. 28.)

Operation No. 10. Pencil decalcomanias with RC-190 or 1950 Combination Size and Pencil Varnish, or brush or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Secs. 4 and 5.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

SPECIFICATION "I"

259 Line Duco over Old Paint or Enamel (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, etc.).

BODY AND HOOD

Operation No. 1. When old finish is in good condition the new finish may be applied over it. Dry sand old finish thoroughly. Clean up carefully to remove all foreign matter. Use clean rag for final wipe. Rust spots, where finish has been broken, should be rubbed bright with emery paper and edges of finish "feathered."

Operation No. 2. Touch up spots with DUX Surfacer (color to be selected) and spray or brush two or more coats of DUX Surfacer on entire body. (See Sec. 19.)

Operation No. 3. After two to four hours, if necessary, glaze with DUX Glazing Putty (color to be selected). Fill nail holes, etc., with DUX 1901 Gray Hard Putty. Allow 12 to 15 hours for drying. (See Sec. 17.)

Operation No. 4. Sand dry. If water sanding is preferred make sure that Surfacer and Putty are hard dry. Clean up and dry thoroughly.

Operation No. 5. Spray two or more coats of 259 Line Duco. (See Sec. 6.)

Operation No. 6. Striping. (See Sec. 29.)

Operation No. 7. Decalcomanias. (See Sec. 28.)

Operation No. 8. Pencil decalcomanias with RC-190 or 1950 Combination Size and Pencil Varnish, or brush or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Secs. 4 and 5.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

SPECIFICATION "J"

259 Line Duco Over Old Lacquer (Except Stake and Express Bodies, Neck Yokes, Wagon Shafts, etc.).

BODY AND HOOD

Operation No. 1. When old finish is in good condition, the new finish may be applied over it. Sand old finish thoroughly with high test gasoline. Clean up carefully to remove all foreign matter. Use clean rag for final wipe. Rust spots, where finish has been broken, should be rubbed bright with emery paper and edges of finish "feathered."

Operation No. 2. Touch up spots with Flexible Pyroxylin Surfacer (color to be selected) and spray two or more coats of Flexible Pyroxylin Surfacer on entire body. (See Sec. 20.)

Operation No. 3. If necessary, spot glaze with 228-1031 Gray Pyroxylin Putty. Allow job to stand about 3 hours. (See Sec. 18.)

Operation No. 4. Rub out with abrasive paper and water. Clean up and dry thoroughly.

Operation No. 5. Spray two or more coats of 259 Line Duco. (See Sec. 6.)

Operation No. 6. Striping. (See Sec. 29.)

Operation No. 7. Decalcomanias. (See Sec. 28.)

Operation No. 8. Pencil decalcomanias with RC-190 or 1950 Combination Size and Pencil Varnish, or spray or brush entire job with RC-190 Automotive Dulux Exterior Clear. (See Secs. 4 and 5.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

(See Sec. 24.)

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

SPECIFICATION "K"

246 Line Duco on New All-Metal Bodies or Burn-Off Jobs on All-Metal Bodies.

Operation No. 1. If burn-off, remove old finish with FV-2061 Blue Diamond Paint and Varnish Remover. (See Sec. 8.)

Operation No. 2. Spray or brush one coat F-6199 Blue Diamond Dark Oxide Metal Primer. Dry 15 to 24 hours. (See Sec. 13.)

Operation No. 3. Spray two or more coats Pyroxylin Surfacer (2331029, 2331035, or 2334274, shade to be selected). (See Sec. 21.) After one hour, if necessary, spot glaze with 2281031 Gray PX Glazing Putty. Dry three hours. (See Sec. 18.)

Operation No. 4. Wet sand with No. 280 or No. 320 abrasive and clean up free from moisture. Blowing out corners with air is good practice.

Operation No. 5. Spray two or more coats of 246 Line Duco. Allow final coat to dry four hours. (See Sec. 7.)

Operation No. 6. Rub and polish with FV-2006 Duco Rubbing Compound No. 2, FV-2063 Duco Rubbing Compound No. 3, or FV-4029 Duco Machine Polishing Compound No. 11. Clean up.

Operation No. 7. Striping. (See Sec. 29.)

Operation No. 8. Decalcomanias. (See Sec. 28.)

Operation No. 9. Pencil decalcomanias with RC-190 or 1950 Combination Size and Pencil Varnish, or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 22.)

WHEELS (WHEN DIFFERENT COLOR IS DESIRED)

(See Sec. 23.)

FENDERS AND SPLASH APRONS (WHEN DIFFERENT COLOR IS DESIRED)

Treat same as body.

INTERIOR OF BODY

(See Sec. 25.)

TOP

Tops of new bodies do not require refinishing. If burn-off job (See Sec. 26).

SPECIFICATION "L"

246 Line Duco Over Old Finish on Metal.

BODY AND HOOD

Operation No. 1. When old finish is in good condition the new finish may be applied over it. If old finish is paint, dry sand thoroughly. If old finish is lacquer, sand thoroughly with high test gasoline. Clean up carefully to remove all foreign matter. Use clean rag for final wipe. Rust spots, where finish has been broken, should be rubbed bright with emery paper and edges of finish "feathered."

Operation No. 2. Touch-up bare spots with 2331538 Pyroxylin Primer and then apply coat over entire body. (See Sec. 13.) And, if surface requires, spray two or more coats of Pyroxylin Surfacer (2331029, 2331035 or 2334274, Color to be selected). (See Sec. 21.) After one hour, if necessary, spot glaze with 2281031 Gray PX Glazing Putty. Dry three hours. (See Sec. 18.)

Operation No. 3. Wet sand with No. 280 or No. 320 abrasive and clean up free from moisture. Blowing out corners with air is good practice.

Operation No. 4. Spray two or more coats 246 Line Duco. Allow final coat to dry four hours. (See Sec. 7.)

Operation No. 5. Rub and polish with FV-2006 Duco Rubbing Compound No. 2, FV-2063 Duco Rubbing Compound No. 3 or FV-4029 Duco Machine Polishing Compound No. 11. Clean up.

Operation No. 6. Striping. (See Sec. 29.)

Operation No. 7. Decalcomanias. (See Sec. 28.)

Operation No. 8. Pencil decalcomanias with RC-190 or 1950 Combination Size and Pencil Varnish, or spray entire job with RC-190 Automotive Dulux Exterior Clear. (See Sec. 4.)

CHASSIS

(See Sec. 22.)

WHEELS

(See Sec. 23.)

FENDERS AND SPLASH APRONS

Treat same as body, using 2512039 Gloss Black, if desired, in place of 246 Line Duco.

INTERIOR OF BODY

(See Sec. 25.)

TOP

(See Sec. 26.)

CHAPTER XXXII

PAINT DIFFICULTIES

(CAUSES AND CURES)

Through the years the du Pont organization has met and solved practically every automotive refinishing problem that can be imagined. In the interests of better refinishing du Pont has made the following information available.

A. Shrinking and Splitting of Primer-Surfacer

Cause:

a. Improper cleaning of surface.
b. Improper "feather-edging" broken area.
c. "Piling on" in heavy coats.

d. Insufficient drying between coats.
e. Fanning air to force drying.
f. Applying on cold surface.

Cure:

a. Use clean rag wet with Prep-Sol to remove wax, polish, and grease. Where bare metal is exposed, sand bright and treat with a metal conditioner.
b. "Feather-edge" old finish about 2″ to 4″ back from edge of spot, finishing up with No. 400 sandpaper to avoid deep scratches.

c. Apply in *medium* wet coats.
d. Allow solvents to "flash" off before applying succeeding coats. Let last coat dry 30 minutes before sanding.
e. Do not fan air to force drying—it causes surface drying and traps thinner which penetrates scratches in old finish.
f. In cold weather, make sure the *metal*, the *primer-surfacer* and the *shop* are approximately the same temperature.

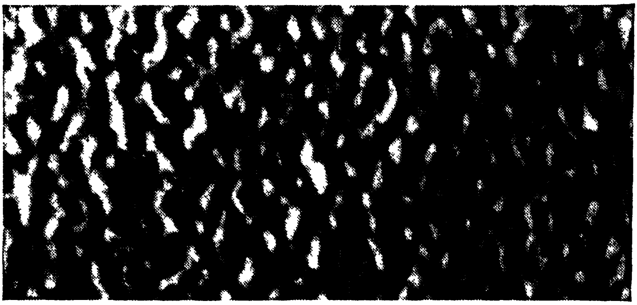
B. Overspray—Dry Spray

This condition is usually found where the finish forms a center line on cowls and turret tops.

If left side of car is painted first, overspray appears to left of center line when right side is sprayed—or vice versa. At this point, gun is held at angle and farther from surface than at other points of stroke.

To overcome, spray side of car on which overspray appears with a wet mist coat. A mist coat is made by adding several parts of thinner to the color left in the cup, or it may be a straight coat of a good thinner.

C. Orange Peel



Cause:
a. Improper atomization.
b. Sprayed improperly.

Cure:

a. Use recommended air pressures at the gun and follow thinning instructions.
b. Use *arm* in full, long strokes, paralleling surface with as little wrist action as possible. Hold gun at right angle to and from 6 to 10 inches from surface.

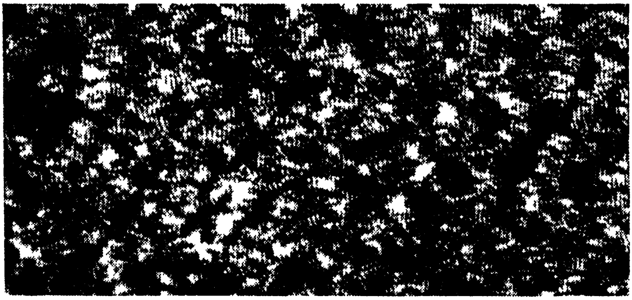
D. Rust Under Film

Caused by presence of rust on surface before finishing—and *no* paint will adhere to a rusty surface.

To avoid this, always sand *all* rust spots bright and treat bare metal with a metal conditioner such as "Deoxidine," "Metalprep," etc., before finishing. Wash with water and dry thoroughly.

Always prime the surface *immediately* after cleaning, as rust will set in if bare metal is exposed too long.

E. Wrinkling of Dulux



Cause:

a. Application of excessive number of coats improperly dried between coats.
b. Overloading of one or more coats.
c. Subjection of air dry Dulux to elevated force dry temperatures without first adding Dulux Baking Reducer.

Cure:

Always follow recommended procedures when reducing and applying successive coats of Dulux, and *always* add RK-5756 to 93 Line if film is to be force dried.

F. Finger Prints Showing

This blistered outline of finger prints shows what can happen when bare hands touch any surface about to be painted. No matter how clean the hands may seem, there is almost always some dirt, grease, oil, or perspiration which will cause blistering, rust, and poor adhesion. *Keep bare hands off the surface!*

In automobile plants, bodies are never directly touched with human hands after being chemically cleaned—the operators wear cotton gloves. It's a good practice for ALL painters to follow!

G. Runs or Sags

Cause:

- a. Too much thinner.
- b. Too heavy coats.
- c. Too wet coats.

Cure:

- a. Reduce material according to label directions.
- b. Regulate fluid adjustment on spray gun (turn to right) to cut down flow of material.
- c. Do not hold gun too close.

H. Pinholing in Lacquers

Cause:

- a. Moisture in spray lines.
- b. Trapped solvents.

c. Insufficient atomization or breaking up of material.

Cure:

a. The drain valve of the air transformer should be opened daily to allow drainage of collected moisture. Remove and clean internal cleaning section of the older type transformers at regular intervals.

b. Do not apply materials too heavily but spray in uniform, normal coats to allow proper evaporation of solvents. Use recommended thinners.

c. Increase pressure of gun for proper atomization.

I. Poor Adhesion

Cause:

a. Improper preparation of surface.

b. Wrong undercoats.

Cure:

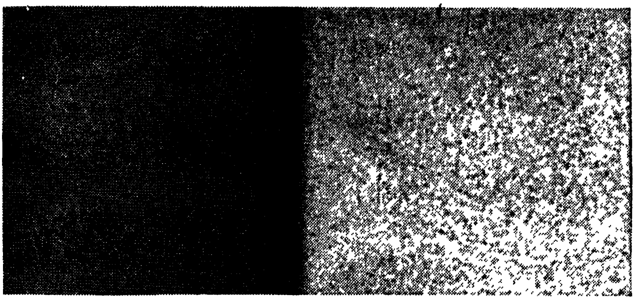
a. Thoroughly clean the old finish with Prep-Sol to remove grease, wax, polish, and other foreign matter. Improper treatment of bare metal surfaces also causes poor adhesion.

b. Follow "Procedures" and label directions.

J. Chalking of Lacquers

The left section of this panel, which was exposed on a paint farm, shows (in comparison with an unexposed section on right) what happens when a finish chalks.

A natural failure, chalking is the gradual breaking up of



the film under weathering and exposure to the sun's rays. It results in a gradual loss of gloss and powdering of the surface.

When this condition is encountered, rub and polish the surface to remove "dead" pigments and get to the "live" film beneath. Then wax the finish to protect and prolong its life.

The use of a mist coat mixed with a slower-drying thinner on a finishing job will enable the film to set better and aid in retarding chalking.

K. Rough, Dirty Finish

Cause:

a. Applying finish over dusty surface.
b. Dirty and dusty shop or spray booth conditions.

Cure:

a. "Tack-wipe" the surface immediately before spraying color coats in order to remove dust and dirt. Tack rags were a regular part of finishing equipment in the old days when varnish was used. Now with synthetics it's a habit to be cultivated again. Get in the tack rag habit. They cost little—and save a lot of headaches.
b. Good housekeeping.

L. Lifting

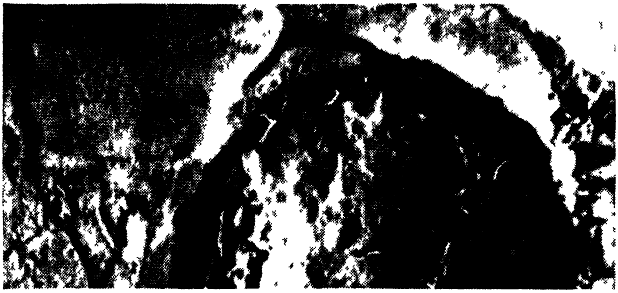
This condition results from applying lacquer type products over unaged air dry synthetic finishes. It also results

from applying a finish over a surface from which old wax, grease, or polish is not thoroughly removed.

To avoid the latter, always clean the old surface with Prep-Sol to remove wax, grease, polish, and other foreign matter before any sanding is done.

Improper recoat time may also cause lifting.

M. Shrinking and Splitting of Putty



Cause:

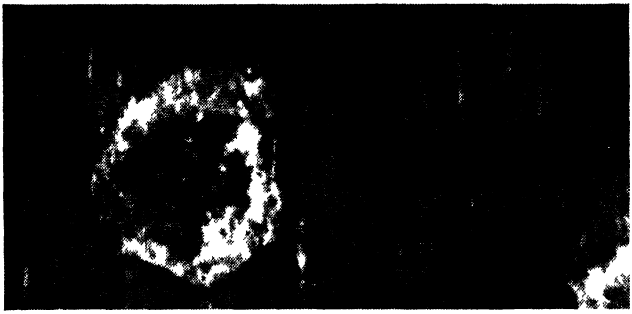
Because putties usually dry quickly, they may shrink, split, and remain soft when applied too heavily, as shown by this close-up.

Cure:

Apply several *light* coats with a glazing knife or squeegee, allow to dry between coats.

N. Wet Spots

If you apply finish over a waxed surface you encounter a difficulty as illustrated on the panel shown here—in this case wet spots which spoil the job.



To avoid this, use Prep-Sol as a cleaning agent to remove wax, grease, and polish from the old surface.

O. Crazing, Cracking, and Checking

Cause:

These conditions, each a degree of the other, result when:

a. Topcoats are applied before the undercoats are dry.
b. Too heavy coats are applied, resulting in non-uniform drying throughout film.
c. New finish is applied over excessively built-up, aged, and cracked old finish.

Cure:

a. *Always* let undercoats dry *thoroughly* before spraying color coats. Weather conditions will alter drying time—so do not follow a standard time.
b. Do not "pile" on coats.
c. If old finish is made up of an excessive number of coats and/or if cracking of the old finish is in evidence, remove the old finish completely before refinishing.

CHAPTER XXXIII

SPRAYING IS SAFE—WHEN PROPERLY DONE

Spraying is as safe as brushing, and lacquer is no more dangerous than gasoline, provided proper precautions are taken.

And by "proper precautions" we do not necessarily mean the immediate erection of an all metal spray room, or anything like that, though such a room has much to commend it. The development of a safe and efficient refinishing department can be accomplished gradually, without upsetting your present organization, and without the immediate expenditure of much money.

The following remarks will apply especially to the person doing lacquer spraying commercially:

Good ventilation, approved equipment properly installed, and cleanliness are the simple essentials for safe work.

Basements are not good locations for spraying. In the first place, they are generally damp, and that is harmful to the finished work. Furthermore, they are difficult to ventilate properly. And should a fire start, it is in a location from which it can work up and do the greatest damage to the rest of the building.

From the foregoing it is obvious that the upper floor of a building is to be preferred. If the building is of fire-proof construction, so much the better. Fireproof buildings are a good precaution, regardless of the kind of work being done. So are automatic sprinkler systems. And when locating the shop, remember that a northern exposure gives the most uniform light—a real advantage at all times and vital when doing the better quality of work, or matching colors.

If windows do not give sufficient light, a skylight will prove a big help. In fact a skylight gives the best distribution of light. Should artificial light be needed, use only electric lights that are protected with vapor proof globes and locate all switches as far as practicable from the actual spraying. Locating artificial light on the sides, rather than on the ceiling, does much to eliminate deep shadows.

Spray Booths and Rooms

While the use of approved spray booths is desirable in all localities it is required in some. For that reason it is suggested that local building requirements be checked up before engaging in paint and lacquer spraying commercially.

If a booth is not provided, the room used for spraying should be as fireproof as it is possible to make it and should be shut off from the rest of the building by self-closing fireproof doors.

If at all possible, provide separate booths or rooms for the spraying of oil undercoaters and lacquer finishes. When the dust from these two different products mixes it is much more combustible than either one by itself. Of course, the logical procedure, when it is impossible to provide separate rooms or booths, is to see that the place used is kept immaculate.

In fact, cleanliness is probably the best fire insurance. The dry dust from spraying is highly combustible and when once ignited burns fast. And of course lacquer and thinner — like any other refinishing materials — are combustible. The supply of refinishing material should be kept in sealed containers and, preferably, in a metal cabinet. It is best to keep the stock of materials outside of the refinishing room away from direct sunlight, and in a fireproof place that is cool and dry.

Whether booth or room is used for refinishing, mechanical ventilation is important. Natural ventilation is too uncertain to depend upon.

Ventilators should be of the motor driven variety. Approved construction calls for the locating of the electric motor out of the stream of air handled by the fan. Furthermore, there should be a metal comb or similar protection that is well grounded and so located that it will discharge static from the belt as fast as produced—thus overcoming the chance of sparking.

One authority on the subject of spraying states that fans should be of such capacity that they provide a complete change of air every three minutes. This rate of air change is sufficient to carry away the fumes and dust and so provide safe, healthful working conditions. A lower rate of air change might prove inadequate—and a higher rate would cause drafts, the latter being injurious to the quality of the finish. If spraying is being done in a booth, the ventilating system can be checked in this way: if, with the spray gun in use no spray or vapor appears at the open end of the booth, the ventilating system is of sufficient capacity. However, if any vapor does appear, the fans should be larger or run faster.

When spraying in a room, it is suggested that the fans be installed about 3 feet above the floor and 12 feet apart. All exhaust fans should be turned on a few moments before beginning to spray and should be left running for several minutes after the spraying has stopped.

Under no circumstances should the exhaust from ventilating fans be permitted to discharge into air passages between buildings or into chimneys. To do so would increase the fire hazard—not reduce it. It is recommended that exhaust stacks be erected to aid the fans in their work. To prevent the accumulation of combustible solids in the stack, baffle plates covered with masking compound can be used. Then when the masking compound becomes covered with spray dust, it can be washed off with water and a new coat of compound applied.

Check everything that could possibly cause a spark. See that all electric motors are of the type that have no commutators to cause sparking or else are fully enclosed. Frames should be grounded. Keep switches of all kinds away from lacquer vapor. Prohibit smoking—**and enforce the ruling**. Never drive a car into or out of the spray room. Always disconnect the battery before bringing a car in. See that no nails project from the shoes worn by the workmen. Nails on concrete or steel floors can cause sparks.

Never use any local heater such as the electric variety. And never use any heater with open flame. All heat should be supplied by either steam, hot water, or hot air. Use enough heat so that the metal never feels chilly to the touch. It is useless to come into a cold shop and try to do good work in the morning. The services of a night attendant or someone who can "boom" the fire about 5 A. M. are well worth while.

And even though every possible precaution against fire has been taken, provide fire extinguishers where they can be quickly found and put into action. Inspect the extinguishers regularly in line with the recommendations of their manufacturers. Keep them fit for active duty. And keep them hanging up where they can be seen.

CHAPTER XXXIV

SELLING REFINISHING—AT A PROFIT

No matter how skillful you are as a refinisher of automobiles and trucks—or how completely your shop may be equipped—there is still one thing more to do.

And that is to make a profit on your skill and equipment.

Other shops are making a profit. So can yours. Let us look at one of these profitable establishments.

The first thing that will attract your attention will be the building. It may not be big or elaborate, but it will be clean, in good repair, windows clean and not filled up with junk. And of course the building will be well painted.

One very successful shop is so arranged that much of the spraying is done right in the front window. Spraying where motorists may see attracts considerable attention to the place. The work fascinates the passers-by and is a good form of advertising.

A certain proprietor who has an especially busy refinishing shop uses three ways of attracting customers. He advertises every week using small space in the local paper, he phones to those whom he can't easily call on personally, and he goes right out and meets as many prospects as possible.

From professional people, whose cars either help or hinder their business progress, he obtains many of his better-grade refinishing jobs. From the used-car departments of some automobile dealers who have not put in their own refinishing departments he gets refinishing work of both low and medium grade.

The quality of the work and the price obtained for it vary with the value of the car.

From the local merchants he obtains numerous refinishing jobs on delivery cars, salesmen's cars, and similar vehicles.

And one especially fine contract was that of completely refinishing five moving vans.

Whenever possible, he gets the prospective customer to visit his shop. In order that the proper impression will be created—and for efficiency and fire prevention, too—the shop is kept spotless.

The typical car owner—either private or commercial—has been educated to shop for a low price. That is unfortunate. However, the better quality jobs can be sold provided it is made clear to each prospect that it is to his own advantage to have the better work done.

That is why the trip to the shop is helpful. It makes it possible to talk about something other than price. Some owners seem to think spray painting is as easy as spray oiling. To offset the idea of some car owners that refinishing with a spray gun is about like turning a hose on a car, this shop operation has a panel on which the various operations are shown.

In the center is a strip of bright metal. At the left is the old finish; at the right the new finish. Each coat of the new finish is applied so that the one beneath projects about two inches. Then with this sample panel before the prospect, this shop owner explains the necessary steps in doing a refinishing job that is right.

If a complete ''burn off'' and refinish job is being sold, the work of removing the old finish is explained. The customer is made to see that failure to completely clean up the metal might save a dollar or two in labor—but would result in the early failure of the finish.

And if a refinishing job over the old lacquer is being sold, the customer is made to appreciate the amount of work involved in sanding down the body, filling cracks, and otherwise preparing the old finish.

Now here's a secret: the average customer is not so dumb in buying automotive service, but some like to play dumb. If they can get away with that, then they can refuse to see why a fair price for a good job is justified. But it's your job to make them to see the fairness of your charges. Many automobile owners are "shoppers." They will hunt for bargains, and a low price is frequently interpreted by such car owners as meaning a bargain.

Whenever you lose a job on price it means that you have not made it clear to your prospect that he will always get just about what he pays for—and that you can give him everything he pays for.

But here is a delicate point. What kind of reputation do you want? Do you wish to be known as a high-grade—and high-priced shop? If so you will get some business.

Or would you prefer to be known for turning out the lowest-priced refinishing job in town? Again, if this is your decision, you will get some business.

Or would you prefer to be known as the fellow who gives each customer just what he wants and what he pays for?

The latter decision is the more profitable, but it requires considerable care when selling the job. It is only natural for the car owner to want as much for his money as he can get. When you are selling a high-grade job at the regular price there is little to fear. But when you are selling a cheap job at a low price be sure your customer knows what he is getting.

In fact, the only safe way to handle such jobs is to clearly state on the repair order just the operations you intend to do. Be specific. Then, if you cannot guarantee the smoothness, gloss, or durability of such a job, write that on the order. Ask the customer to read the order carefully and sign it. If there is going to be any misunderstanding, it is far better to clear it up before the job is started rather than after it is finished.

But these suggestions apply only in those cases where the customer insists on the cheapest possible job.

Contrary to the experience of some, the better-grade jobs are not hard to sell. Of course, not all owners can afford the very finest—and not all cars need the best kind of refinishing—but a good job done with good material is the most economical in the long run. And it is the kind of job that builds a reputation for your shop.

And speaking of reputation, the make of finish you use can do much for you. It is far easier to sell a customer a refinishing job when you mention that the material you use is some well-known brand. But if you decide to use some brand that is not well advertised—and as a consequence, not well known—be sure you know good reasons why the customer should have this make of finish. The makers of different finishes have various claims for their finishes. Be sure you know the sales story on the finish you use almost as well as the salesman who sold you the finish knows it.

Ask the supplier of the finish for any and all sales helps that he can furnish. And after you get these helps, **use them.** Manufacturers spend much time and money preparing such material. But it has no value until you place it in the hands of those who might be in the market for a refinishing job.

But how can you locate such prospects? There are several ways.

One of the best ways is to note the license numbers of cars that might be refinished to advantage. By this is meant that you would not consider a car that was an ''ancient crock'' as a prospective job, even though it did need refinishing. (And it probably would need it.) Neither would you consider a fairly new car of medium to high price classification to be a prospective job if it bore every sign of being abused by its owner.

Some owners you can sell, and some you can't. And there's no use of wasting time and postage or phone calls on the latter type.

The likely prospect is the fellow whose car has pretty good tires, fenders that are not all in bad condition, and upholstering that is in fairly good shape. If the car is too far gone the fellow will probably either trade it in soon—or else he doesn't care what it looks like.

So in picking prospective jobs use your own good judgment. You will thus bring a higher number of jobs into the shop than would be the case if every car with finish in bad condition were listed as a prospective job.

Having obtained the license number, the next step is to look up the name and address of the owner of the car. This can be done by obtaining an automobile registration list from the Secretary of State, through the local motor clubs, or from R. L. Polk & Company, Detroit, Mich.

The first step, then, is to mail your prospect a piece of literature on refinishing. A day or two after that has arrived a phone call or personal call should be made provided the name looks like a "hot" prospect. Otherwise another piece or two of direct mail material could be used to advantage and the personal call made later.

But this is true—it takes constant, intelligent work to sell automobile refinishing—or any other commodity—at a profit.

However, the present trend among automobile owners is to keep their cars longer than was the custom in the past. Furthermore, automobiles over the last few years have been so highly developed in design that a car a few years old does not look "ancient" if the finish is in good condition.

For these reasons there is a worth-while volume of refinishing business. And it is going to the shops that are equipped to do a good job at a fair price and that constantly tell the motoring public of the services they offer.

CHAPTER XXXV

HINTS FOR REFINISHERS

Good work is possible only with good equipment and material.

Use thinner of the same brand as the lacquer you are using.

Two thin coats dry faster and give better results than one thick coat.

In equipping a shop get equipment with sufficient capacity to provide for growth.

Cheap equipment is no economy.

Pressure variations upset the "pattern" of the spray.

The center of the spray is generally the "wettest"—be sure the edges overlap.

Read and heed the instructions of the manufacturer of your spray equipment.

Read and heed the instructions of the manufacturer of your materials.

Keep your air conditioner clean. Drain it daily.

A small touch-up gun with an assortment of color in small containers is a good investment.

Never put equipment away without cleaning thoroughly.

A clean shop is a safe shop.

Placing paint tube in thinner and pulling trigger of gun quickly and thoroughly cleans all passages.

Steel drums should not be used under pressure.

Do not use steel floors. They may cause sparks—and sparks are dangerous.

A drop of oil on the working parts of your gun smooths the action and preserves the mechanism.

Never use pliers on your gun—use a wrench.

A round spray is best for wheel spokes and other small areas.

Keep your gun moving if you would avoid runs and sags.

Use a fan spray and overlap your strokes when covering panels.

Keep your spraying strokes parallel.

Low air pressure causes rough finishes.

Holding the gun too far from the surface causes excessive dust and gives a poor finish.

Holding the gun too close tends to cause sags and runs.

Pin holes in the finish are generally due to water or oil in the air lines.

Always make the first coat of lacquer light. That seals the under coats.

Gas sand lacquers, but not lacquer undercoaters. The gas attacks the gum in undercoats.

The longer the last coat of lacquer dries, the more brilliant will be the finish when rubbed.

Thinner will quickly remove lacquer from metal parts.

Keep your spray booth or room well ventilated but avoid drafts.

A cool spray room may cause pitting of the finish.

A temperature of 70° is recommended for spraying and drying.

Keep lacquers and similar supplies in a steel cabinet—and in a room of about 70°.

Excessive sanding or use of coarse paper causes scratches to show when refinishing over old lacquer.

Keep the hands off the bare metal or finish of a car. Oil in the skin or perspiration injures lacquer.

Paint removers contain wax and this should be wiped from the surface with turpentine before spraying.

Use nothing but lights protected with vapor proof globes in a refinishing room.

Lacquer spraying is not hazardous if proper precautions are taken against fire.

Foam type fire extinguishers are good insurance in any shop.

Run your exhaust fan for a few moments after you have stopped spraying.

Ground all electric motors, switches, etc., to guard against sparks.

Never install an electric motor inside of a spray booth.

Place a metal comb, well grounded, so as to keep static electricity from accumulating on belts.

Never drive an automobile under its own power into or out of the finishing room.

Disconnect the battery of every car that enters your refinishing room.

Invite your local fire or insurance inspector to check over your shop. He is your friend. Follow his suggestions.

When polishing the finish use a ribbed cloth. It holds the polishing material better than plain cloth.

All finishes break down in time. That is due to either chalking, cracking, or peeling.

Premature chalking most commonly results from excessive pigment in the finish—possibly as a result of settling in the container.

Cracking may result from applying additional coats without waiting long enough for the undercoats to dry thoroughly.

Peeling indicates that the surface on which the new finish was sprayed was not properly cleaned up.

Orange peel effect may result from too much air pressure, finish applied too thick, or insufficient thinner.

Slow drying generally indicates thick application, oily surface, or failure to remove all traces of paint remover.

Lacquer and equipment manufacturers want you to get the best possible results from their products. Take up specific questions with them.

CHAPTER XXXVI

PRINCIPLES OF GLASS SERVICE

Any major body repair job is likely to require glass replacement. For this reason it is well for the body service man to be familiar with the principles of glass service even though he may choose to "farm out" this work to a glass specialist.

Relatively little equipment is needed for glass service work though the larger shops that go in for this work in a big way have fairly elaborate set ups. Assuming that facilities are already at hand for the removal and replacement of window lifts and windshields or window frames, the main equipment will be as follows:

Carpet-covered work bench
Heater coil for cutting safety glass
Edger for smoothing exposed edges of glass
Glass cutter, glass pliers, mallet, etc.

The main supplies needed will include a small stock of standard-size glass obtainable from some automotive jobbers and from all glass supply houses, channel packing to hold the channel tight to the glass, cement for similar use, and a standard assortment of window glass-run channels.

Space hardly permits listing or picturing all of the accessories and items of equipment available to workers in the replacement glass business. For this reason it is here suggested that those contemplating going into this work get the catalogs of H. G. Lange Machine Works, and also of Sommer & Maca Glass Machinery Company, both of Chicago, Illinois. Such literature is filled with illustrations and suggestions on all phases of glass work, showing both supplies and equipment.

Three basic kinds of glass are used in automobiles. The older cars have plate glass, while the newer cars all have safety glass. Two kinds of safety glass are in use. The safety glass used until 1940 was built up of two thin sheets of glass using a sheet of plastic that was not very elastic. The very latest safety glass has a highly elastic yet extremely tough plastic material for the center section.

Only safety glass should be used in any repair job on any car, bus, or truck.

The fundamental of glass cutting is similar for all kinds of glass but varies only in detail. The cutting is done with a regular glass cutter over an exact paper pattern. The pattern is laid on the carpeted work bench and the glass to be cut is laid on this. Then with a steady hand on the curves and a straight edge on the straight portions, the cutting is done. A little kerosene spread with a paint brush along the place to be cut makes for a cleaner cut with less wear on the cutter.

The accuracy of the paper pattern is the foundation of a good glass job. Paper patterns should be made up and filed away for future use and no opportunity should ever be missed to add to this accumulation of patterns. The patterns are drawn on heavy brown paper and used as seen in Fig. 232.

Fig. 232. Using pattern drawn on heavy paper as guide for cutting glass.

In addition to the cut outlining the exact shape of the finished piece, cuts are also made to the edge of the piece so that all unwanted portions of the glass may be readily removed and discarded. With the cut accurately made, the next step will depend on the kind of safety glass used.

The kind of safety glass used almost universally prior to 1940 had to be heated after using the cutter in order to complete the cutting operation. This heating was done along the cut with the aid of a heater coil, very much like the nichrome wire heating element in a small electrical room heater. This heating coil is held in place along the cut by small metal blocks as seen in Fig. 233 and as the heat penetrates the plastic it softens and the glass can then be parted smoothly along the cut.

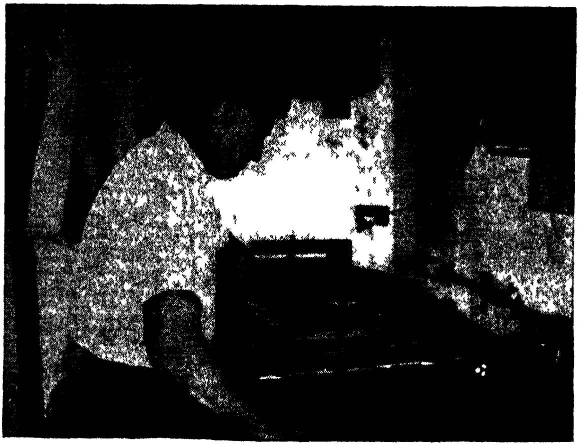


Fig 233. Using glass pliers and heater wire to complete the cutting of old type safety glass.

The latest extremely flexible plastic allows sufficient

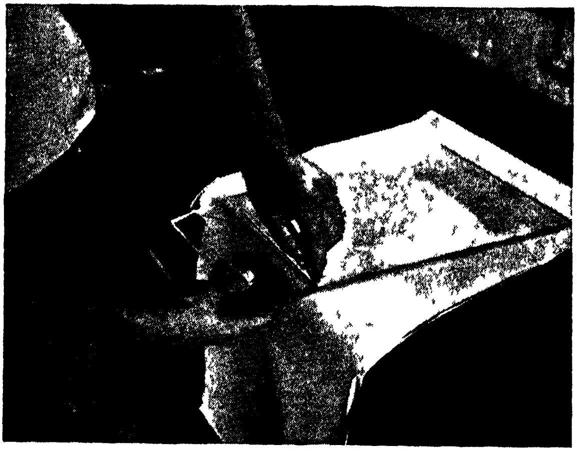


Fig. 234. Safety razor blade cutting the new flexible plastic in latest safety glass.

"give" after using the glass cutter that by giving the glass a sharp but light rap under the cut while bearing down on the projecting edge of the glass the glass can be made to spread. The plastic is then severed with a safety razor blade as shown in Fig. 234.

With the safety glass that requires heating to part the plastic, the plastic should be undercut from the edge of the glass and the edge sealed against the intrusion of air and moisture with a "sealer." This sealing compound is available from all glass supply houses. Failure to take this precaution will result in the early discoloration of the glass and weakening of the whole sheet. This procedure is not necessary on the newest safety glass since the flexibility of the plastic and the bond obtained between it and the glass assures permanence of the union and the exclusion of destructive agents.

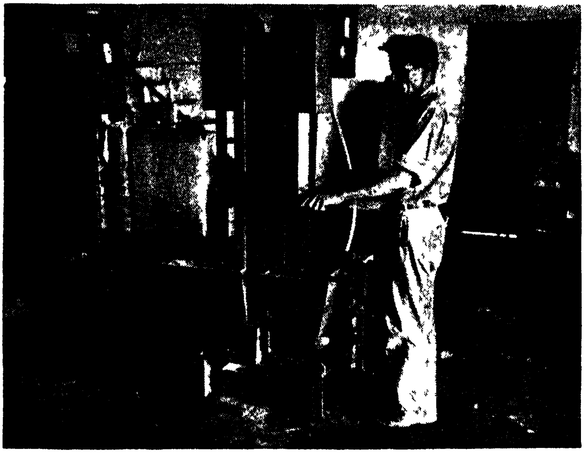


Fig. 235. Double belt edger for finishing the edges of glass after cutting.

Having the new glass roughly cut, the next job is edging. This can be very speedily and effectively done by grinding the exposed edges and the edges that are to run in channels with one of the emery belt machines. One of the latest of these is seen in Fig. 235. This machine is a double belt edger where with the use of two coarse belts two operators can turn out work at high speed. Normally, however, one belt will be coarse and the other fine so that the coarse one can speed up the rough work and the fine one give a good finish. Fig. 236 shows a home-made version of the belt-type glass edger. Here, by changing grinding belts, the rough work and finishing can be done quite speedily.

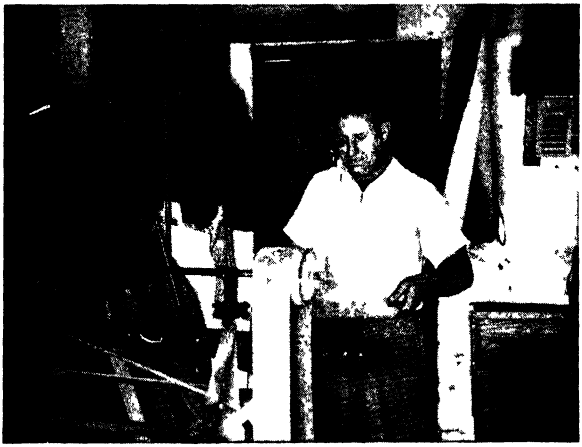


Fig. 236. A home made glass edger of the abrasive belt variety.

The larger shops generally include the wet-wheel type edgers, for with their large flat surfaces, as on the horizontal wheel seen in the foreground of Fig. 237, edges can

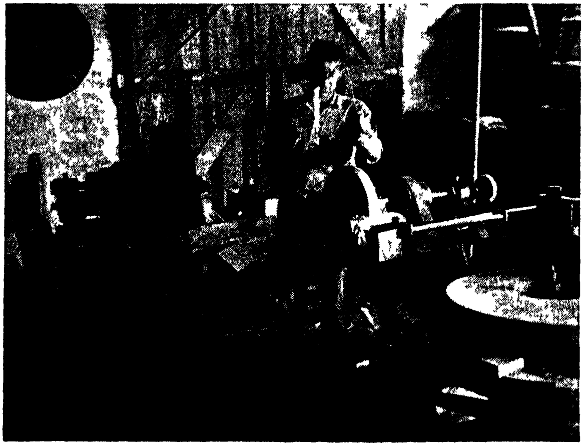


Fig. 237. Wet-wheel glass edger with both horizontal and vertical abrasive wheels.

be kept straight. In the grooved wheel on which the operator is working, a uniform curve can be imparted to the edge by means of the groove. This wheel is very fine and imparts a high finish to the glass.

Great care must be exercised when fitting curved glass as used in the rear of so many of the newest cars. In fact any glass installed under tension is likely to crack in service resulting in loss and annoyance all around. So most service men at present prefer to obtain exact duplicates of curved glass from the car dealers whose cars they are servicing. In this way the glass contour and body lines will be alike and likelihood of breakage in service is reduced.

When applying the bottom channel to a window glass, a careful check of channel width and glass thickness must be made. Allowance for a cork or composition strip is made but the thickness must be such that the channel will just drive down under the impact of a heavy rubber mallet as seen in Fig. 238. Too tight a fit may cause glass breakage while too loose a fit will mean that the channel will work loose in service. And when applying the channel great care must be exercised to get it located exactly as the old one was or the window lift will not line up and work properly.

Water leakage around glass and especially at the front windshield can be a source of great annoyance to motorists but of great profit to shops that can really handle this

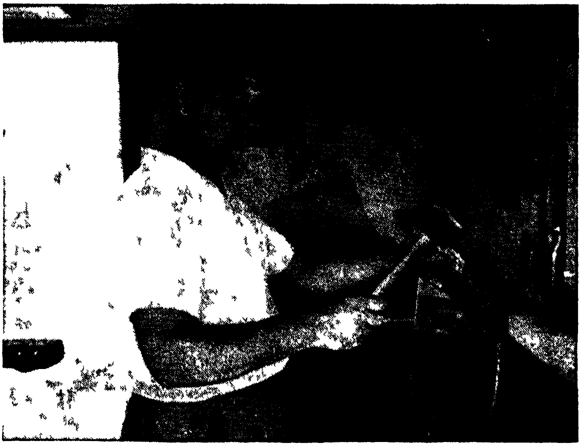


Fig. 238. Using rubber mallet to drive channel firmly into place.

kind of work. In a windshield that opens, for example, there can be four places right at the frame where water gets in. Obviously one would look to see that the rubber sealing strip touches the body at all points. But leakage has been stopped by cementing the rubber strip into the windshield frame. And similarly some service men have taken windshields apart, as seen in Fig. 239, and reinstalled the glass with tighter fitting composition strips between the frame and glass. And others have found that the "windshield" leak was not in the windshield at all but in the cowl ventilator.

Fig. 239. Repacking windshield glass to stop water leaks

So the glass service man, like any service man, must be constantly on the alert for the unusual if he is to make the most of his opportunities.

CHAPTER XXXVII

FUNDAMENTALS OF UPHOLSTERY WORK

Since modern service work makes it unnecessary in many cases to disturb upholstery there are many men who just never get around to "picking up" this line of experience. And others dodge the job by replacing complete upholstery panels if a piece is badly torn, while others call it "sissy work" and never have anything to do with any job that is related to a needle and thread. But anyone who has taken time to look into the job possibilities in specialized upholstery service knows that there are some mighty smart "he men" making motoring more pleasant by improving the interior appearance of cars and more comfortable by fitting seat covers in tailor-made fashion, and rebuilding seats to fit the people who ride on them.

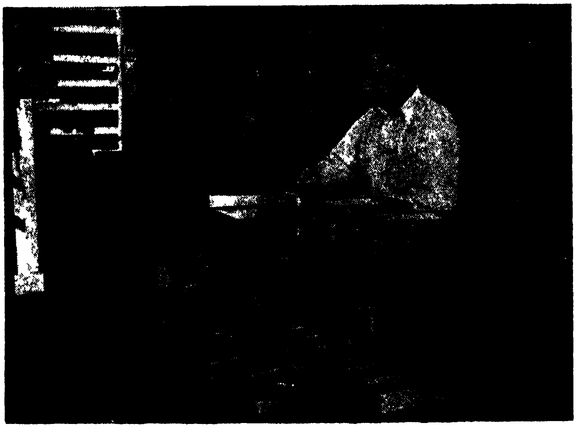


Fig. 240. Jobber of trimmers' supplies showing large variety of items carried.

We have no quarrel with those who just don't "take" to upholstery work. But a man who is a good mechanic can make a good upholstery or trim man due to his understanding of hinges, latches, seat controls and the like. And in the small shop especially a little study of upholstery work can often be the cause of worth while raises and advancement for a mechanic who might otherwise be "just another mechanic."

Since the jobber of trimmers' supplies carries somewhere around 5,000 items needed by upholsterers and trimmers it is evident that reference cannot be here made to everything required in this work. But to those interested in this field it is suggested that a visit be paid to the nearest jobber in order to see just what supplies are available in this field. Fig. 240 shows a progressive jobber in a southern city and gives some idea of the variety of tools, fittings, and trimmings available. Fig. 241 is another view in this same jobber's establishment and gives a good idea of the vast variety of top and upholstery cloths carried. Note also the young lady filling an order for some trim moulding, and high above her some rolls of seat padding. In the foreground is a card advertising "re-silencer," a material used to make sheet metal jobs quiet after servicing. Below the rolls of seat padding are complete replacement seat upholstery sets with all padding in place. Seat covers for popular makes of cars are in boxes high and to the right.

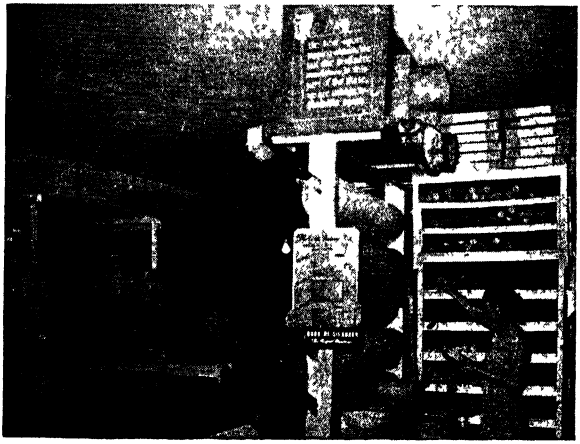


Fig. 241. Fabrics, trim strips and other items used by trimmers.

So this, briefly, is what a jobber of trimmers' supplies carries and until you have spent some time studying his stock you are likely to waste plenty of time trying to fix some trifling part that might better be replaced. We have watched a good mechanic spend over an hour straightening out 20c worth of moulding, seen another make a 2c screw in a lathe, watched others salvage binding from around seats that were being repaired when new binding would have cost less than the value of the time required to salvage the old material and would have made the job look right. So by all means visit your nearest jobber and study his stock.

It is common knowledge that the big automotive market is in the small car field. And it is equally well known that many of these cheaper cars, while excellent mechanically, have been built with an eye to cost. So it is but natural that the manufacturers had to "cut corners" somewhere, and if you will but feel the seats of cars costing under $1000 and compare their softness and comfort with cars costing over $1000 you will know one place where money has been saved. To many car owners this means little. To others it is a cause of concern—especially on long trips—and many a smart trimmer makes good money rebuilding seats for greater comfort.

Fig. 242. Comparison of thickness of air-foam rubber used in different car seats.

Fig. 242 gives an idea of the relative thickness of the air-foam rubber that is receiving so much publicity in connection with increased motoring comfort. The advertising of different cars may sound very similar but the actual material in those cars may vary considerably. Admittedly the use of air-foam rubber increases comfort, but it is essential to have enough of it under one to really absorb shocks or it won't be impressive—except in the ads. In Fig. 242 the large piece of air-foam rubber on the bench was removed from a seat and the seat was rebuilt with air-foam rubber of the thickness seen in the square sample on top.

By studying construction carefully, one can rebuild a seat for greater comfort. The basic idea is to remove the old springs, if few and stiff, and replace them with a greater number of springs with greater resiliency. Springs of different height are available at the jobber's and where more padding is to be added, lower springs should be used in order that the overall height of the seat will remain practically unchanged. Whether one uses conventional padding or the new sponge rubber greater comfort is sure to result where a production seat has been converted into a custom built one.

Probably the most used piece of shop equipment in the trim shop is the sewing machine which is generally built into a bench as seen in Fig. 243. Here any flat work can be quickly and permanently sewed together. Here seat covers are altered to be really tailored to the car. And some trimmers even build their own seat covers.

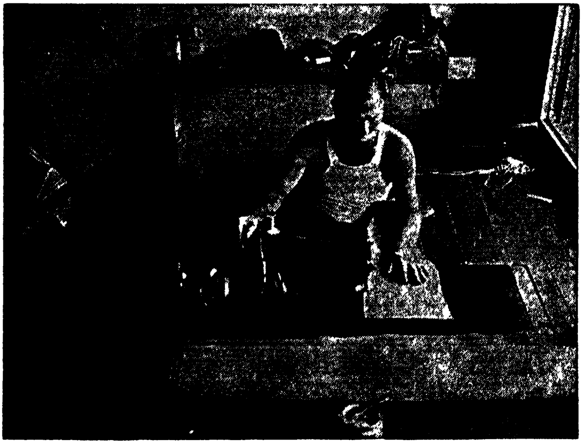


Fig. 243. Sewing machine built into bench for use on large work.

In upholstery and trim work, perhaps more than in some other fields, there is nothing quite like working as an apprentice to a skilled man. Here you will see him adjust padding of a seat without removing the covering cloth or even leaving a mark on it. With a long blunt needle he pierces the cloth and with this needle works the padding around to remove lumps. Distressing rips in fine fabric he will probably draw gently together with an under-and-over stitch like that used to sew the cover on a baseball, then with flexible cement on the reverse side he will make the cloth stronger than new, and the tear will be hardly noticeable. A rip in the cloth covering of a door panel he will sew neatly together with a curved needle that makes it unnecessary to lift the cloth from the door panel. He will sink small round headed tacks so deftly into upholstery that it will be impossible to tell what is holding the material in place.

All in all the upholstery field is one worth studying for here is combined the skill of the expert tailor with the ability of the most capable mechanic.

CHAPTER XXXVIII

FRAME STRAIGHTENING

The big-money jobs frequently require frame work. The man who is prepared to do this work himself is in line for extra profit. And in the shop that is not equipped for this type of work, a body man who understands the problems can buy this service for his organization to best advantage.

So, whether equipped for this profitable service or not, it is important to be familiar with the fundamental types of frame damage and the most efficient manner of correcting each condition.

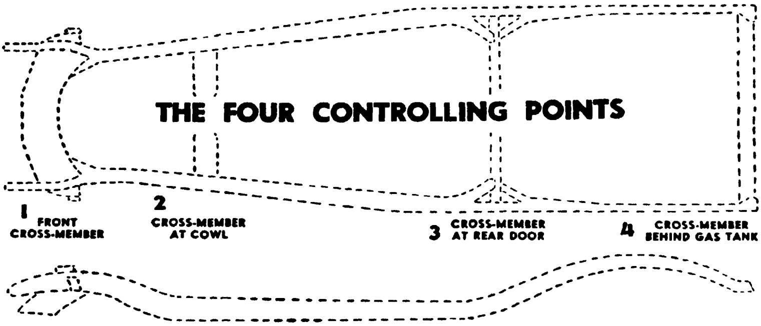

THE FOUR CONTROLLING POINTS
1 FRONT CROSS-MEMBER
2 CROSS-MEMBER AT COWL
3 CROSS-MEMBER AT REAR DOOR
4 CROSS-MEMBER BEHIND GAS TANK

Fig. 244. A typical automobile frame showing the four control points.

By special arrangement with the Bear Manufacturing Company, the material in this chapter is made available. It is based on years of study and the analysis of literally hundreds of different types of repair jobs.

There are *five major types of misalignment* that may act upon the four controlling points of a car frame (Fig. 244). One or more types may be present, depending upon the severity of the collision. The harder the impact the more types of misalignment will be found upon thorough inspection. These types or degrees of misalignment are:

Collision occurring in front:

1. Bent frame horn (minor).
2. Sidesway at cowl, both sides (first major bend).
3. Sag at cowl, on side hit (second major bend).
4. Mashed siderail just behind front cross member.
5. Diamond frame.
6. Twisted frame.

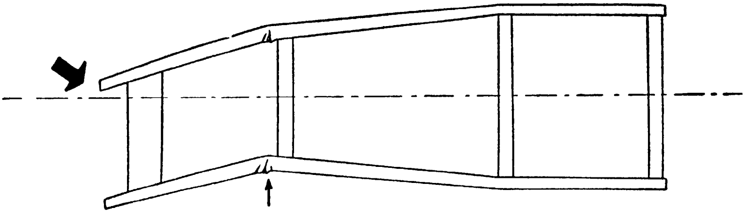


Fig. 245. Sway from front end collision.

Collision occurring in rear:

1. Mashed frame over rear housing.
2. Sidesway over rear housing or at rear door.
3. Sag at rear door.

There are four points in the car frame that control the tracking of all four wheels. Bends and sags at these points result in misalignment. These four points are:

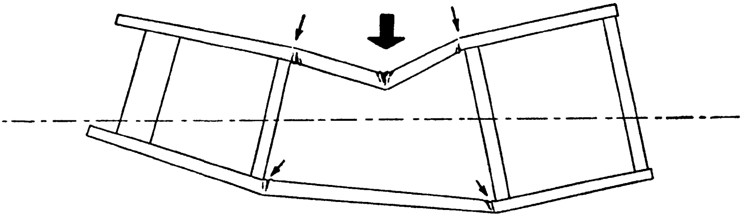


Fig. 246. Sway from collision in center.

1. Front cross member.
2. Cross member at cowl or where X member and siderail meet.

3. Cross member at rear door or where X member and siderail meet.
4. Cross member behind gas tank.

Figures 245 to 253 inclusive show independent major bends. They show the exact spots where bends can be found, not the order in which they may occur.

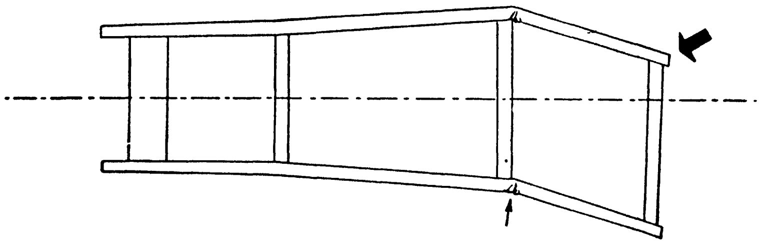


Fig. 247. Sway from rear end collision.

In all diagrams the heavy arrow indicates the direction of impact resulting in damage, small arrows point out buckles in siderails. Sway is misalignment of the frame laterally and shows up in a greater or less degree in both siderails, depending upon the direction from which the impact is received. Figs. 245, 246 and 247 represent in simplified style the condition of the frame after collisions at front, in center, and at rear.

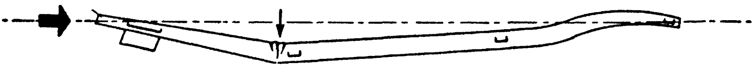


Fig. 248. Siderail sag from front end collision.

Siderail sag is misalignment of the frame due to buckling of either the right or left siderail upon impact. Weight of the motor or car body causes the siderail to drop. In the diagrams in Figs. 248 and 249 the frame is viewed from the side.

Mashed frame and buckled siderail result from a heavier impact than is represented in the foregoing examples. In addition to siderail sag and buckling on top of siderail, the

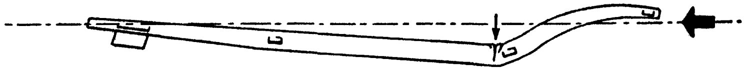


Fig. 249. Siderail sag from rear end collision.

frame is bent down and buckled underneath the siderail (Figs. 250 and 251).

Diamond frame (Fig. 252) results from an impact on either corner of the car frame, sufficient to push the cross members out of right angle to the siderail.

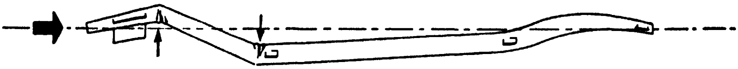


Fig. 250. Frame mashed and buckled from front end collision.

Twisted frame (Fig. 253) results from a collision when there is an extra heavy load on the chassis causing it to turn over, or tend to turn, on its side.

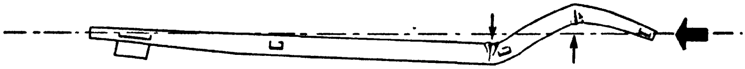


Fig. 251. Frame mashed and buckled from rear end collision.

Bear equipment is designed to correct these conditions without removing the car or truck body.

You, as a body man, may ask, "When should a passenger car frame be checked?"

The answer is

1. "Whenever a car has been involved in an accident, no matter how minor.
2. When the complete wheel alignment inspection reveals a bent frame horn.
3. When tracking is off more than ⅛ inch."

The good frame operator will always make a visual check of the condition of the car chassis before going ahead with his gauge inspection. He should get underneath and examine every segment of cross members and siderails for buckles, rips, and tears. Knowing the location of each bit of damage of that nature will help him considerably in interpreting his gauge readings.

Also, before beginning the gauge inspection, the operator should sketch the frame on the floor with a piece of chalk or with a pencil so that he can note the location of his findings. In this way, when he has finished the visual and gauge inspections, he will have a diagram of the job and will be better able to set up his frame machine to make the necessary corrections. Following are the Bear gauges used to check for major frame bends:

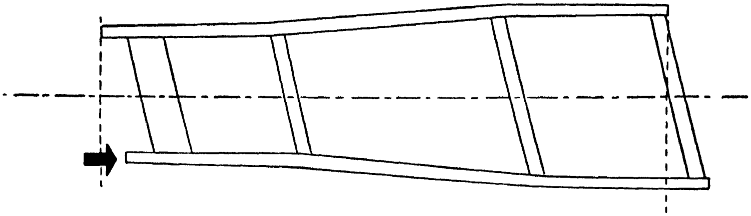


Fig. 252. Diamond frame from corner collision.

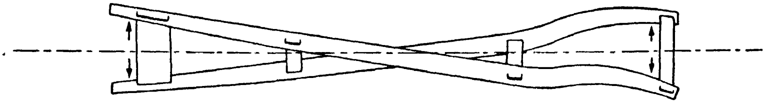


Fig. 253. Twisted from turn-over accident.

Sidesway—Frame centering gauges.
Sag—Frame centering gauges.
Mashed or buckled siderail—Measuring rods.
Twist—Frame centering gauges.
Diamond—Tracking gauge.

The Complete Frame Alignment Inspection

Checking for Sidesway

All sighting is done with the pointers of the frame centering gauges. The following procedure should be used when car has been hit in the front, or incorrect tracking has been found during alignment inspection:

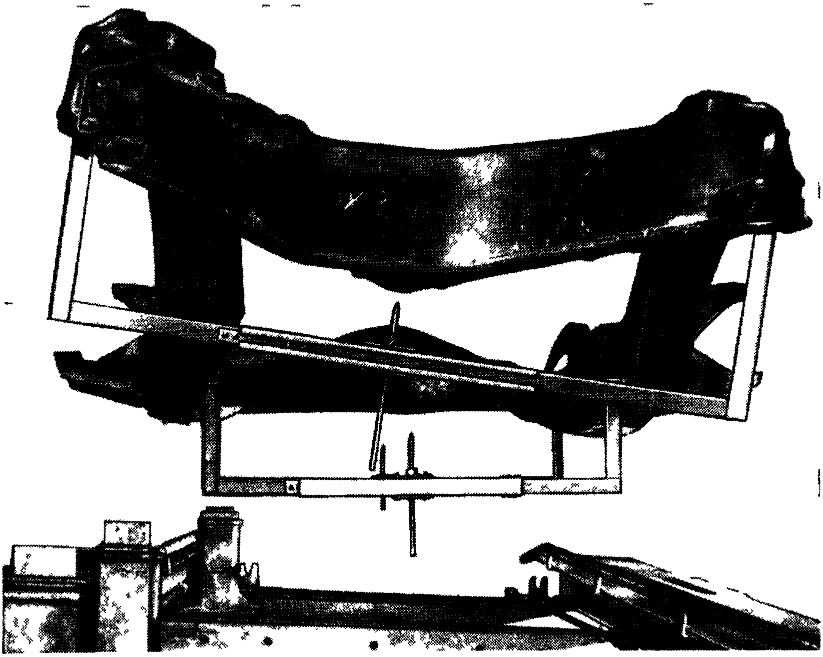


Fig 254 Sighting down centering gauges for sidesway at cowl.

1. Place first gauge just ahead of front cross member, second approximately at cowl, and third at cross member behind gas tank. (See Fig. 254.)
2. Sight the three pointers from the front.
3. If the pointers are not in line, and you know the car has been hit near the front, sidesway is likely to be found at the cowl (where hood and body meet).

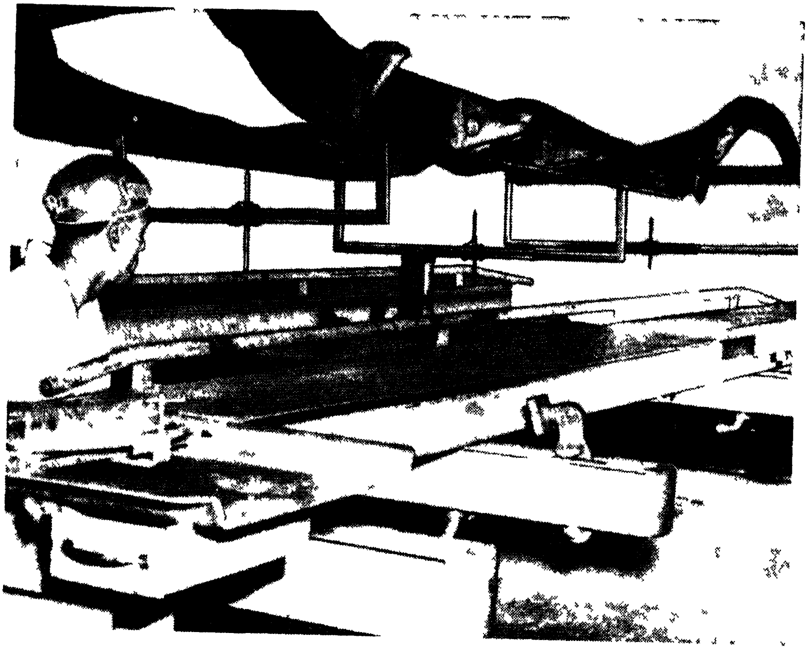


Fig 255 Sighting down centering gauges for sidesway at rear.

4. To make a checkup, remove front gauge and place it in position at cross member nearest rear door (or where X member and siderail meet). (See Fig. 255.)
5. Sight pointers. If the three pointers line up, this is proof that the sidesway is at the cowl.
6. If pointers *do not* line up and are in approximately the same relationship with each other as they were in the first check, this indicates frame may be swayed at rear door or just over housing.
7. If pointers are off center about half the amount shown in the first check, it indicates that the bend is near the middle of the car and both ends are swayed.

The following procedure should be used when the car has been hit in the rear:

1. Only change in procedure just given, in checking a car known to have been hit in the rear, is to place

middle gauge at rear door instead of at the cowl. Sight from rear instead of the front.

2. If pointers do not line up, sidesway may be at one or two points, just over rear housing or at point where cross or X member and siderails meet (rear door.)

Checking for Sag

All sighting is done on the cross bars of the frame centering gauge to determine whether or not they are level or parallel with each other. The following procedure should be used when car has been hit anywhere in the front section:

1. Place gauge at front cross member, at cowl, and at cross member behind gas tank.
2. Sight cross bars from front (Fig. 254).
3. If first and second cross bars are not parallel with each other, a sag condition is present at the cowl.
4. Because the frame from the cowl back has a tendency to remain in line, the front corner of the sagged siderail will rise. Thus, the sagged siderail will be found on the *high side* of the cross bar of the front gauge.
5. A siderail may sag as much as six inches without affecting the rail on the opposite side. In all cases, the opposite siderail should be inspected for buckles at the cowl. Seldom will the operator find both siderails sagged on a passenger car.

The following procedure should be used when a car has been hit in the rear:

1. Place gauges at cross member behind gas tank at rear door and at front cross member.
2. Sight gauges from the rear. If cross bar on rear gauge is obviously not level with the middle and front gauge bars, look for a sag condition at rear doors. If a sag condition exists, top of siderails will have buckles at point where X member and siderail, or cross member meet.

Mashed Frame

In checking for this condition when car has been hit from the front:

1. Make visual check of siderail just behind front cross member. If mashed condition exists, buckles will be found on the under side of the siderail.
2. A comparison check is made using the measuring rods. Place one end of the rod at a rivet head or a hole on the outside of the siderail at the cross member. Place the other end at a similar point on the siderail near the cowl. (See Fig. 256). An alternate method is to use a tracking gauge as in Fig. 257. Then take rod and place in exactly the same relative position on the opposite siderail. Thus, you can determine the amount the siderail has been mashed and buckled.
3. If checking a car with conventional axle, look for the mashed condition just ahead of the front cross member.

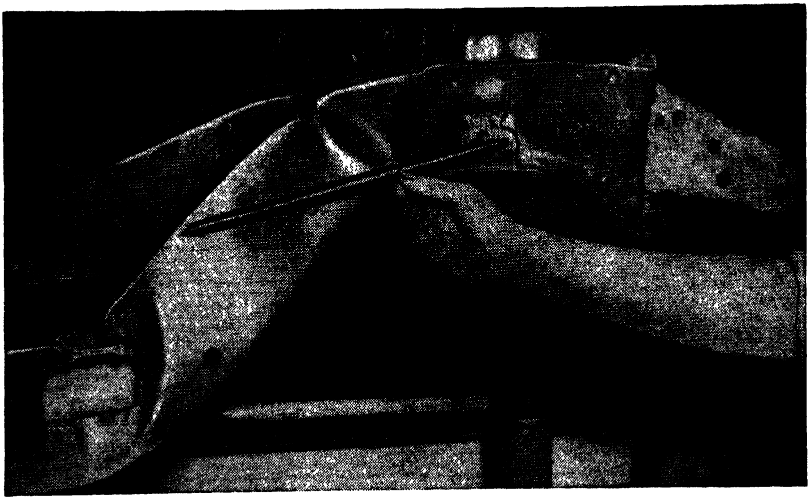


Fig. 256. Using measuring rod to compare opposite sides.

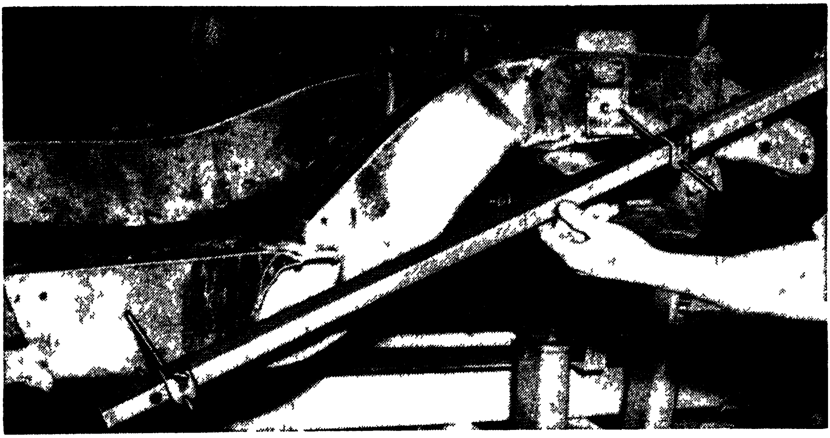


Fig 257 Tracking gauge used to check extent of mash

Checking for mashed frame when the car has been hit in the rear:

1. When use of the frame centering gauges indicate a bent frame at rear, look for buckles over rear housing on under side of siderail

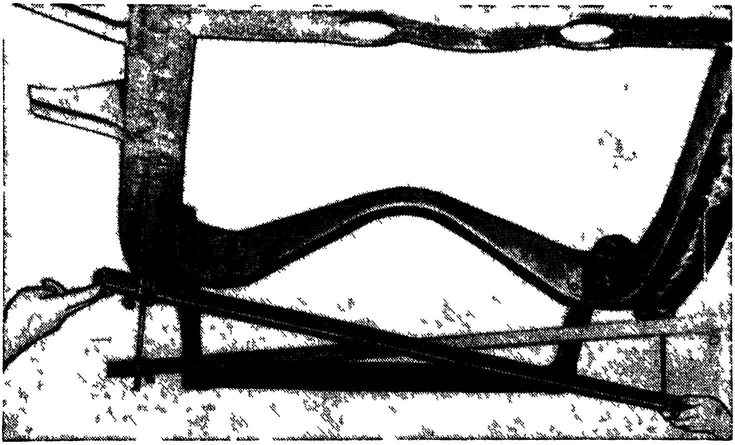


Fig 258 Checking diamond condition with tracking gauge.

2. Use measuring rods to check the amount of mash or buckle. To check the arch over the rear housing,

which contains the buckled or mashed area, place one end of the rod at a point near the rear cross member and the other at a point near the rear door (as in Fig. 259). Check opposite siderail in the same manner to determine the amount of mash or buckle.

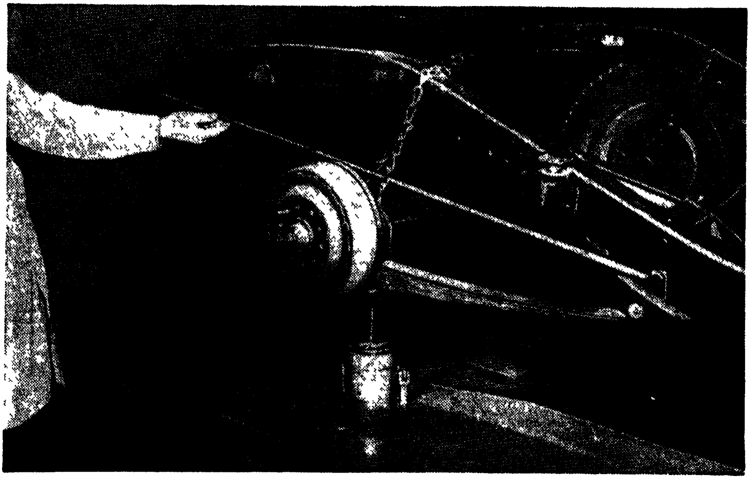


Fig. 259. Checking frame arch with extended measuring rod.

Checking for Diamond

When the car has been hit in front, use one section of a tracking gauge with two pointers:

1. Make criss-cross check of a section of frame that has not been damaged. As a general rule this check should be made in the middle section (Fig. 258). Frames of X or K member construction are not likely to have a diamond condition.
2. Place one end of tracking gauge at a point on the siderail near cowl. Then run the gauge diagonally to a point on the opposite siderail near the rear door. Then reverse gauge and compare measurements.

Checking for Twisted Frame

This check should be made when the car has had serious body damage. The check is made by using two of the three frame centering gauges. Place one gauge at the cowl and the other at the rear door. If the cross bars are not parallel or level with each other a twisted frame is indicated.

With present day high speed cars, there are more and more collisions resulting in mashed frames. Any passenger car frame straightening job can be undertaken with confidence on the part of the operator if he understands and keeps in mind this basic principle:

> *When making a hookup to restore a passenger car frame to manufacturer's specifications, provide for a stretching pull wherever possible, in conjunction with ordinary push or pull.*

For instance, when correcting sags or sidesways caused by end blows, use a stretching pull with the usual hookup. This procedure eliminates any danger of collapsing the siderail where push is being applied. Also, the siderail will be returned to normal more easily, because the stretching pull relaxes buckles, and only one-third the pressure will be required to do the job as when push alone is applied. (See Fig. 260.)

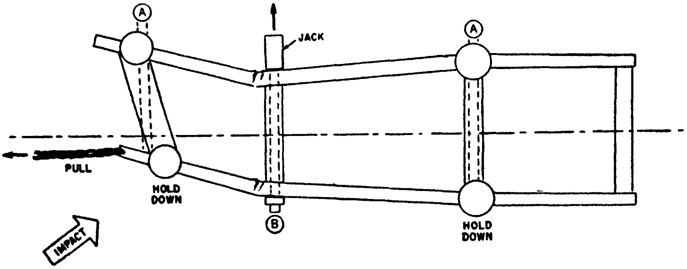


Fig. 260. Hook-up for sidesway and sag correction.

The stretching pull reverses the direction of the impact which caused the damage. When a siderail is hit hard at one end, it will sag because the impact has shortened the overall length. By pushing up, at 90 degrees, the siderail may be straightened, but it will remain short. A stretching pull will restore the frame to its proper length.

Always remember that the key to frame straightening lies in these three principles:

Diagnosis: Detailed appraisal of damage to car or truck; determining condition of frame; knowing how many major bends there are and how great each one is;

Preparation: Getting car or truck ready for straightening; and

Complete Hook-up: Making proper setup of jacks and hold-downs on straightening machine as prescribed by the manufacturer of the equipment.

Let's see how some typical jobs are handled.

Problem No. 1: Straightening the Bent Frame Horn (Fig. 261)

1. Where both frame horns are bent, they should be straightened individually.
2. When frame horn is bent in:
   a. Apply pressure evenly by pumping jack handle. Buckles near the cross member on the top and bottom flanges will have a tendency to even out as the end of the horn moves back into position. However, it is advisable to rap both top and bottom flanges smartly with a hammer to relax the metal. A flange wrench will help to relax the buckles also.

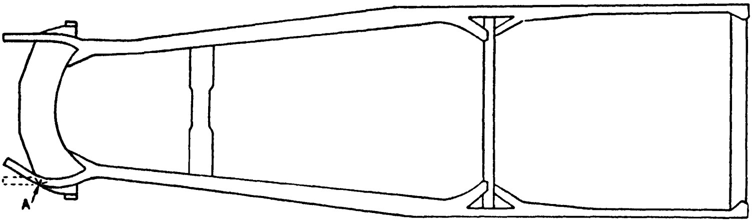


Fig. 261. Bent frame horn.

3. When frame horn is bent out:
   a. Here the problem is different because the flange metal has been stretched and, as a result, buckles will appear as the horn is brought back into position.
   b. As pressure is applied, take a flange wrench and start the buckle in the direction it will be the easiest to remove.
   c. After horn is back in position, continue to hold a light pressure against the end of the horn until buckles have been ironed out. Use controlled heat with a dolly or block under the buckle. In frame straightening, only a small amount of heat is required to relax buckles and weld cracks. A very little heat is needed to correct steering linkage. Automotive engineers agree on the use of *controlled* heat but there are many mechanics who do not use heat properly. To apply controlled heat, use a large tip. Open the acetylene valve a little, light the torch and then open the acetylene valve until the sooty black smoke just disappears from the end of the flame. Then open the oxygen valve and the red flame will turn blue. Continue to open this valve until the blue flame pulls down into an inner cone, just out of the end of the tip. When the feather edges have disappeared from the blue cone, you have a neutral flame, suitable for working without damage to the metal. In using heat to relax buckles, do not "spot heat," but fan the flame out over a large area. Start well out on the buckles and move the torch in a circular motion toward the center. In this way a large area is heated to a cherry red. Spot heating will result in overheating and damage to the frame, which will make correction more difficult. In repairing steering linkage, fan the heat out over a large area. This will remove the chill, preventing it from rushing in on the hot area and hardening it, causing damage to the steering linkage.

With *controlled heat* applied, the first three sharp licks with the hammer should do the trick.

d. When frame horn is mashed against cross member it may take two or three "bites" with the upright before the end gets out far enough to put the final pull on it.

Problem No. 2: Bent Frame Horn and Swayed Frame (Minor) (Fig. 262)

1. In the case of minor sidesway, the sidesway is corrected first and then frame horns are pulled in position as in Problem No. 1.

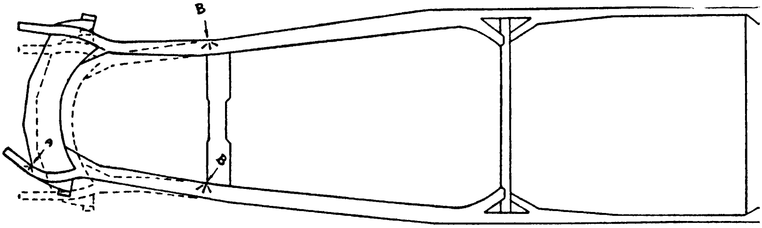


Fig. 262. Bent frame horn plus swayed frame (minor).

2. Where there is sidesway of a half inch, the frame will have to be pulled into position and past a similar amount. Do not make the correction in one pull. Instead, first make a test pull and release pressure with a snap. From this the operator should be able to judge amount sidesway will have to be pulled so that the frame will drop back into the right position when all pressure is released. On this particular hookup, the frame gauges should be in position so that the operator can keep tab on the amount of his pull.
3. There are not likely to be any buckles in the siderails where only minor sidesway is evident. However, if any are found, they should be relaxed by hammering as the frame is being corrected.

Problem No. 3: Bent Frame Horn and Siderail Sagged at Cowl (Minor) (Fig. 263)

1. In the case of minor sag, the sag is corrected first. Frame horns are pulled back into position as in Problem 1.
2. When the amount of sag is a half inch or less, it will be necessary to push the siderail into position and beyond normal position an amount equal to the sag, one half inch. Do not make the correction in one push. Instead, first make a test push, releasing pressure with a snap. From this operation, the operator should be able to judge the amount the siderail will have to be pushed to make the siderail drop back into position when pressure is released. On this hookup, the frame gauges should be in position so that the operator can judge more easily the amount of pressure required.
3. It is unlikely that there will be any buckles in the siderail when only minor sag is evident. However, if any buckles are found, they should be relaxed by brisk strokes of a hammer while pressure is being applied.

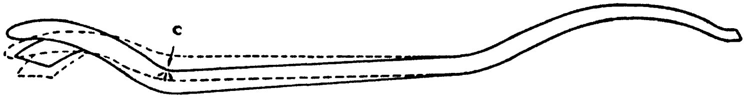


Fig. 263. Bent frame horn and siderail sagged at cowl (minor).

Problem No. 4: The Two-Way Bend—Sag and Sway (Minor), Plus Bent Frame Horn (Fig. 264)

In this case where both sidesway and sag are minor—one half inch or less—the frame horns are corrected last. A combination hookup restores the frame siderail to manufacturer's specifications in virtually one operation. When sag and sidesway are attacked separately, there is danger of re-creating sag when correcting for sidesway, or vice versa.

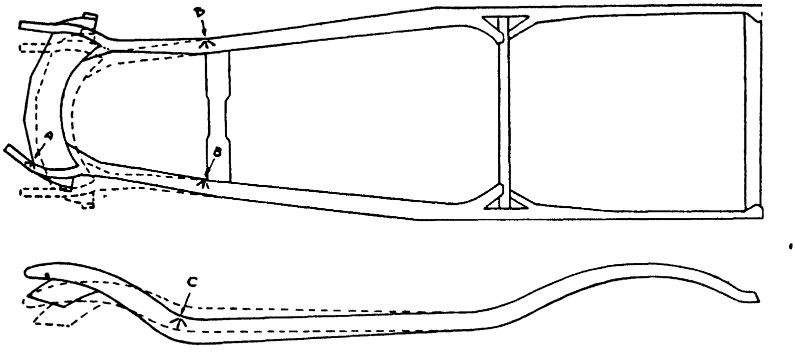


Fig. 264. Side and top views of two-way bend composed of sag and sway (minor) plus bent frame horn.

Problem No. 5: The 3-Way Bend—(Major) Front Sidesway—Sag at Cowl—Siderail Buckled Behind Front Cross Member—Plus Bent Horn (Fig. 265)

This problem presents the most common condition of frame misalignment arising from a major collision where

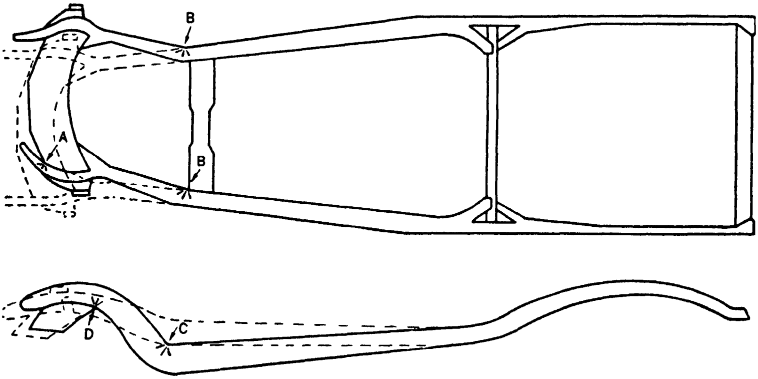


Fig. 265. Side and top views of three-way bend (major). This includes front sidesway, sag at cowl, and siderail buckled, plus bent horn.

the car has been hit in the front, head-on or on either the right or left corners. Due to the construction of the present automobile frame, bends resulting from any major front end collision will fall into the same general pattern. The main thing to remember in this type of problem is that *all* *the bends went in at the same time.* Therefore, they must be removed at the same time with opposite pressures. Thus, the introduction of *stretching pull.* When frame has been sideswayed as in Problems No. 2 and 4, and sagged as in Problems 3 and 4, only a minor amount (one half inch or less) the conventional hookup can be used. However, when the damage exceeds that amount, the siderails must be returned to proper alignment by means of a stretching pull to prevent new buckling and to prevent the rails being short when the job is finished.

This problem is handled in three steps:

1. First rough frame horns into position (minor bends).
2. Make hookup and correct 3 major bends according to equipment manufacturer's instructions.
3. Put finishing touches on frame horns and front cross member.

Problem No. 6: The Four-Way Bend—Front Sidesway, Sag at Cowl, Siderail Buckled Behind Front Cross Member, Diamond Frame and Bent Frame Horns (Major) (Fig. 266)

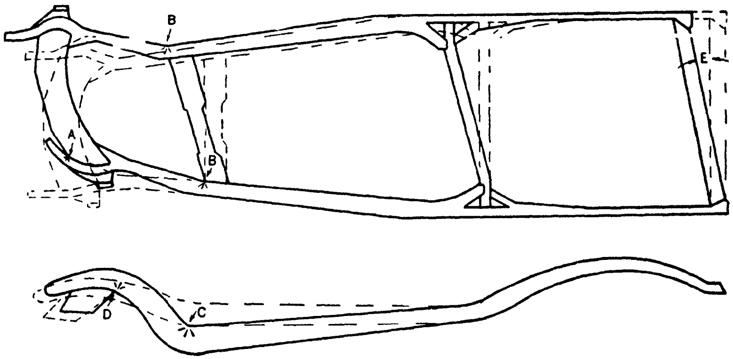


Fig. 266. Side and top views of four-way bend (major). This includes sidesway, sag at cowl, siderail buckled, diamond frame and bent frame horns.

The hookup for straightening a frame with four-way bend is essentially the same as that for the three-way bend. However, the extra bend (*E*) is handled by changing the location of the pull bar assembly at the rear of the frame machine.

Problem No. 7: Siderail Bent in Center, Causing Sidesway at Both Ends (Fig. 267)

Here is illustrated a condition resulting from a severe blow on the side, causing the frame to sway at both ends.

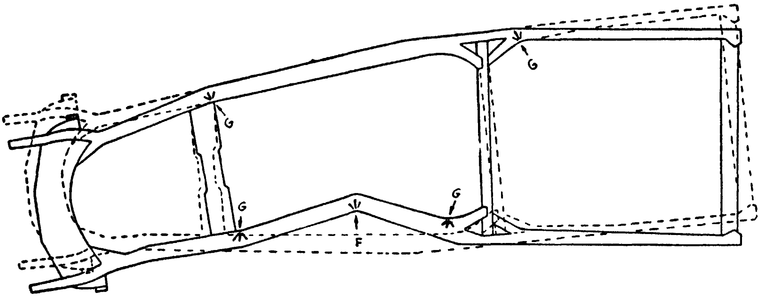


Fig. 267. Siderail bent in center causing sidesway at ends.

In addition to the conventional hookup for removing this type of bend, the stretching pull must be employed.

Problem No. 8: The Twisted Frame (Fig. 268)

Removing a twist from a frame is a comparatively simple operation. However, care should be taken to make the

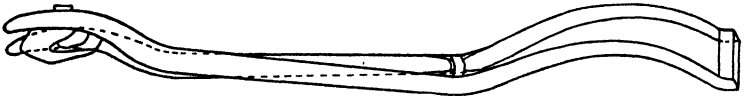


Fig. 268. Twisted frame.

proper hookup to do the job as efficiently as possible.

First, remember that a twist is never corrected as part of another operation. If the frame has other bends, they should be corrected first. The last operation will be the removal of the twist.

Frame gauges should be in position during the straightening.

Make the hookup, putting jacks under the low spots and tying down the high corners. Do not set up on the ends as the distances to be pushed by the jacks will be too great. Rather, place the front jack and tie-down at the cowl, and the rear jack and tie-down near the rear door or where X member and side members meet.

Problem No. 9: Siderail Mashed and Buckled at Rear, Sagged at Rear Door (Fig. 269)

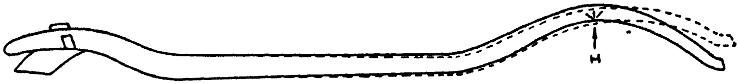


Fig. 269. Siderail mashed and buckled at rear with sag at rear door.

The hook-up for this job is similar to that used in correcting buckled siderail and sag at cowl, as covered in Problem 6, except that the stretching pull is applied at the rear.

Problem No. 10: Replacing Damaged Cross Members

To remove the old cross member, cut the heads off the rivets with a cutting torch so they can be punched through. If a cutting torch is not available, it is best to drill the heads of rivets, then knock them off with chisel and hammer. If you remove rivets without drilling them, they will turn over on one side and loosen. After removing heads, knock them out with a punch.

Cut any welds or flanges attached to cross members. On cars with conventional axles, without coil springs or offset in siderail, it is unnecessary to cut flanges. If the car has a U-channel frame, cut top and bottom flanges behind cross member. Cut on the side opposite the point where frame was mashed, using hack saw or cutting torch, *without cutting siderail.* By this method the siderail can be pushed out very easily so that the cross member can be removed without difficulty. Bend frame horn outward and remove cross member.

In installing the cross member, use drift punches (three or four) to align holes, first bolting cross member in position. Then remove punches and bolts one at a time and run an oversize drill through each hole and use oversize rivets to fasten permanently.

The length of rivet that should protrude through the frame, to be broken down as a head, should be one and one-half times its diameter. Place the rivet in position and buck with a bucking bar. Heat the rivet close to the flame-flange, allowing heat to creep up and down the rivet. Also allow heat to creep out into the flange in an area approximately the size of a half-dollar. *Do not start heating rivet at the top.* Then, with a hammer, break it down, hitting it squarely to obtain a flat top with round head. When installing front cross members, welds should be added to flanges and cross members to obtain greater strength.

CHAPTER XXXIX

GETTING A JOB

So now you want a job as a body and fender repair man. Fine. There is a big field for experienced men in this line and they make good money and enjoy steady employment.

"What experience have you had?" will be the first question asked you by your prospective employer. So your first job is to get experience. Maybe this sounds impossible —you can't get a job without experience, and you can't get experience without a job.

But wait a minute. Look at the employer's side of this matter. Just why in the world should he be willing to pay you money for service of unknown value. He shouldn't; and he isn't. But the average employer will gladly pay a fair price for a fair value and it is your job to prove to him that you can do what you claim you can do.

Maybe in line with the many suggestions in this book you have obtained experience of a kind. Possibly in a trade school or on your own time you have obtained an old fender or door panel and done a presentable job of fixing it. This is a step in the right direction but it is not enough. You still need actual commercial shop experience.

So go to some used car dealer. Expect no immediate cash return for your effort. Do a selling job of getting a job. Some of the best known products today are sold on a money back basis. So you—an unknown "product" so far as the prospective employer is concerned—have got to "guarantee" your services by asking nothing but a chance to prove what you can do.

Make no strong claims. As a beginner it is not expected that you will be worth much. But surely you will be worth something in any used car department. Remember that right now all you want is a chance to gain experience under regular commercial conditions. The best paid jobs in many of the trades and professions can be had only after long study followed by an apprenticeship frequently of years.

So plan to GIVE if you hope to GET. You will give your time and energy; you will get experience and eventually a job. And the more you give the more you will get. Don't forget that this also holds true after you are on the pay roll. The "boss" has to take in money from your efforts before he can fill your pay envelope. And the more he takes in the more he can put in the old envelope. So try to learn the GIVING side of work and the GETTING will take care of itself, and quite satisfactorily.

To make the best impression you should dress for work. And if you have a small kit of tools similar to the one at the top of page 22 you may be sure that any shop owner will gladly listen to you. Don't talk with the boys in the shop. Inquire for the owner. He is the one who signs the checks. He is the one who will hire you, or refuse to. When you meet him and he asks you what you want look him squarely in the eye and say something like this:

"I want a job as a helper in your body department. And I don't want a nickel of pay until you see what I'm worth. You've got nothing to lose on this proposition. What do you say?"

The average business man is a good sport and if there is a chance in the world of working a serious-minded young man in on such a basis the chances are that he will say, "Okeh."

Then you are all set to do your stuff. Remember, even though you're not getting a dime of pay you should work as though you were getting top wages and perhaps some day you will. But if you reason that since you are drawing no pay you can take a day off now and then or come in late in the morning and take two hours for lunch, you're going to completely offset the good impression that you might make by your work.

Remember, you asked for this opportunity. Generally the offer to put in a month at no pay will be accepted. And when it is, WORK. What of it if at the end of the month you still can't get on the payroll? You got what you really needed—EXPERIENCE. And with it you got confidence. Now you are all set to go to another shop and say, "I've fixed dozens of fenders for so-and-so, I can replace a damaged door panel and do other body jobs." Your air of assurance plus the fact that you have had experience in a shop will probably land you a job.

And if you continue to study and work the job will soon hunt for you instead of your having to hunt for the job.

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